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JOURNAL

# of the Bombay Natural History Society

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Vol. 80, No. 1

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BOMBAY NATURAL HISTORY
SOCIETY

1983 APRIL Vol. 80 No. 1

LARGE MAMMALIAN PREY — PREDATORS IN BANDIPUR[1]

A. J. T. JOHNSINGH[2]

(*With eight plates & fourteen text-figures*)

Large mammalian prey species and predators were studied in a 32 Km² area around Bandipur village in the Bandipur Tiger Reserve, Karnataka, between August 1976 and July 1978. Chital (*Axis axis*) comprised 69% and sambar (*Cervus unicolor*) 13 to 14% of prey number. The fertility rate of chital does was 1.3 and that of sambar does was 1. The average biomass of the hoofed prey species was 3320 Kg/Km²; including elephant (*Elephas maximus*) the average ungulate biomass was 9831 Kg/Km².

Dholes (*Cuon alpinus*) accounted for 80%, leopards (*Panthera pardus*) 15% and tiger (*Panthera tigris*) 5% of the 379 kills collected. Ratio of predator to prey biomass was 1:124. Annually the predators removed nearly 20% of the standing crop of the hoofed prey. This high predation rate was possibly because of the sudden removal of 100 + cattle from the study area which were grazing till the beginning of the study.

Hunting habits of dholes are described. Antipredator behaviour of the prey species, their ecological adaptations to breeding, biomass, and various ecological parameters which separate the predators are discussed. Calculations on the effect of predation on chital and sambar and the impact of stealing kills are presented.

INTRODUCTION

In the last two decades some important field studies on the large carnivores have been conducted in the Indian subcontinent (Fig. 1 and Table 1). Species studied include leopard *Panthera pardus* (Eisenberg and Lockhart 1972, Muckenhirn and Eisenberg 1973, Seidensticker 1976a), sloth bear *Melursus ursinus* (Eisenberg and Lockhart 1972, Laurie and Seidensticker 1977), tiger *Panthera tigris* (Schaller 1967, Seidensticker 1976a, McDougal 1977, Panwar 1979, Sunquist 1981) and lion *Panthera leo persica* (Joslin 1973, Berwick 1976). The techniques adopted varied from natural history observations (Schaller 1967,

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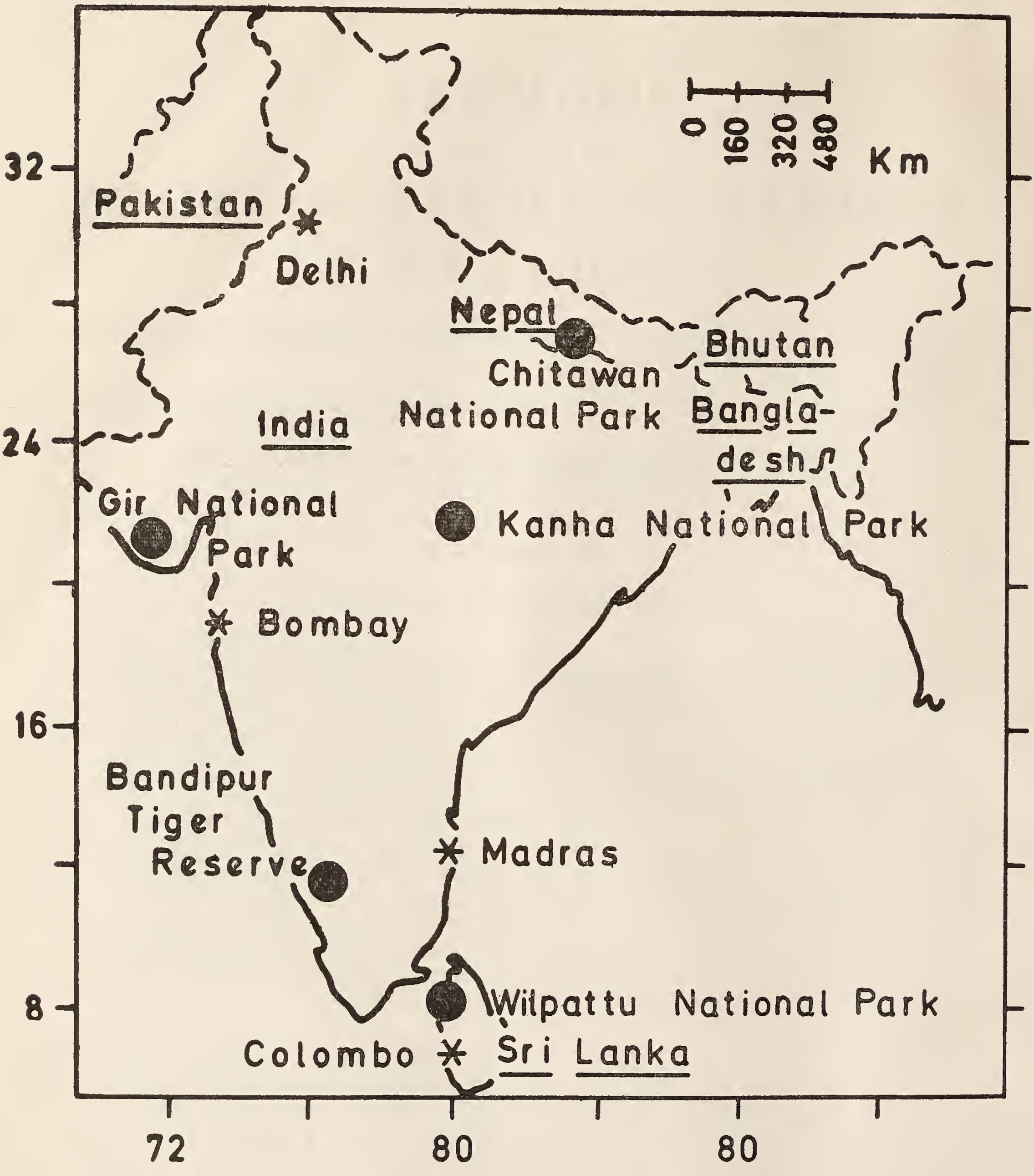
[1] Accepted April 1982.

[2] Project Scientist, Endangered Species, Bombay Natural History Society, Shahid Bhagat Singh Road, Bombay-400 023.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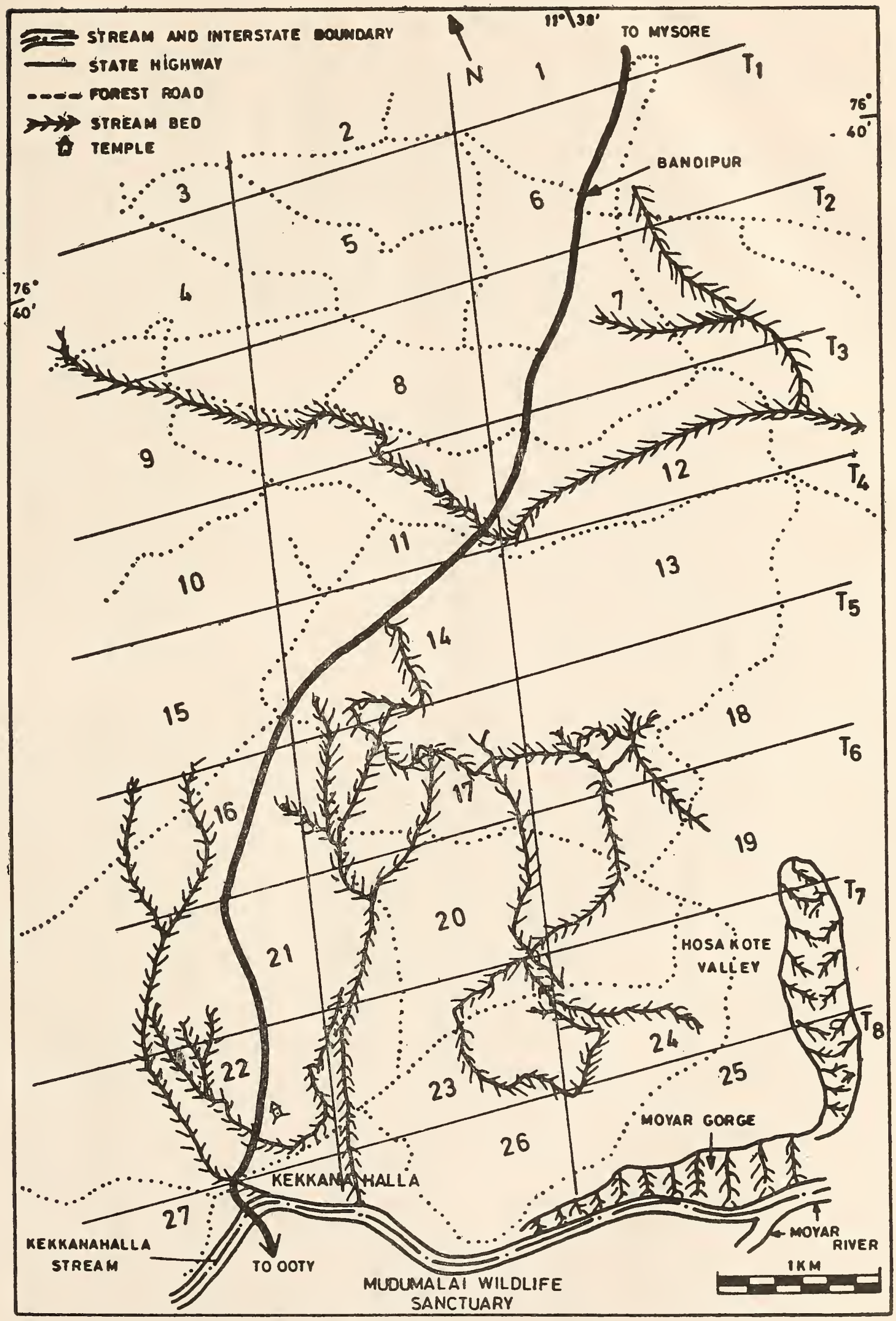
Delhi
Nepal
Chitawan National Park
Bhutan
Bangla-desh
India
Gir National Park
Kanha National Park
Bombay
Bandipur Tiger Reserve
Madras
Wilpattu National Park
Colombo
Sri Lanka

Fig. 1. LOCATIONS OF LONG-TERM STUDY SITES OF CARNIVORES IN THE INDIAN SUBCONTINENT.


STREAM AND INTERSTATE BOUNDARY
STATE HIGHWAY
FOREST ROAD
STREAM BED
TEMPLE
N
11° 38'
TO MYSORE
76° 40'
76° 40'
BANDIPUR
T1
T2
T3
T4
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HOSA KOTE VALLEY
MOYAR GORGE
KEKKANAHALLA
KEKKANAHALLA STREAM
TO OOTY
MUDUMALAI WILDLIFE SANCTUARY
MOYAR RIVER
1 KM

Fig. 2. Transect lines (T) and sectors of the study area.

TABLE 1

MAJOR LONG TERM STUDIES OF THE CARNIVORES IN THE INDIAN SUB-CONTINENT

Author	Study Site	Major floral characteristics of the study site	Major aspects of the study
Schaller 1967	Kanha National Park, Madhya Pradesh	Grass meadow — Sal forest	Tiger and its prey species
Panwar 1979	"	"	Population dynamics and land tenures of tigers
Joslin 1973	Gir National Park, Gujarat	Dry deciduous scrub jungle	Ecology of the Asiatic lion
Muckenhirn and Eisenberg 1973	Wilpattu National Park, Sri Lanka	Littoral monsoon scrub and monsoon forest	Home ranges and predation by Ceylon leopard
Seidensticker 1976	Royal Chitawan National Park, Nepal	Sal and riverine forest	Ecological isolation between tiger and leopard
Laurie and Seidensticker 1977	"	"	Behavioural ecology of the sloth bear
McDougal 1977	"	"	Ecology and behaviour of the tiger
Sunquist 1981	"	"	Social organization of the tiger
Present study	Bandipur Tiger Reserve, Karnataka	Dry deciduous forest, *Anogeissus latifolia — Tectona grandis* dominance	Ecology and behaviour of the dhole or Asiatic wild dog

Eisenberg and Lockhart 1972, Joslin 1973, Muckenhirn and Eisenberg 1973, Berwick 1976, Laurie and Seidensticker 1977, McDougal 1977, Panwar 1979) to radio telemetry (Seidensticker 1976a, Sunquist 1981).

I observed large ungulates and their predators in Bandipur from August 1976 to July 1978. The major purpose of this study was to assess the effect of dhole (*Cuon alpinus*) predation on chital (*Axis axis*) as Sharatchandra and Gadgil (1975) found dhole to be the major predator of chital and concluded that the chital population was declining. To compare the predatory habits of the dhole with those of the leopard and tiger kill data were collected for all three carnivores. Information was also collected on population density, movement patterns, reproduction, mortality, antipredator behaviour and biomass of the prey species.

STUDY AREA

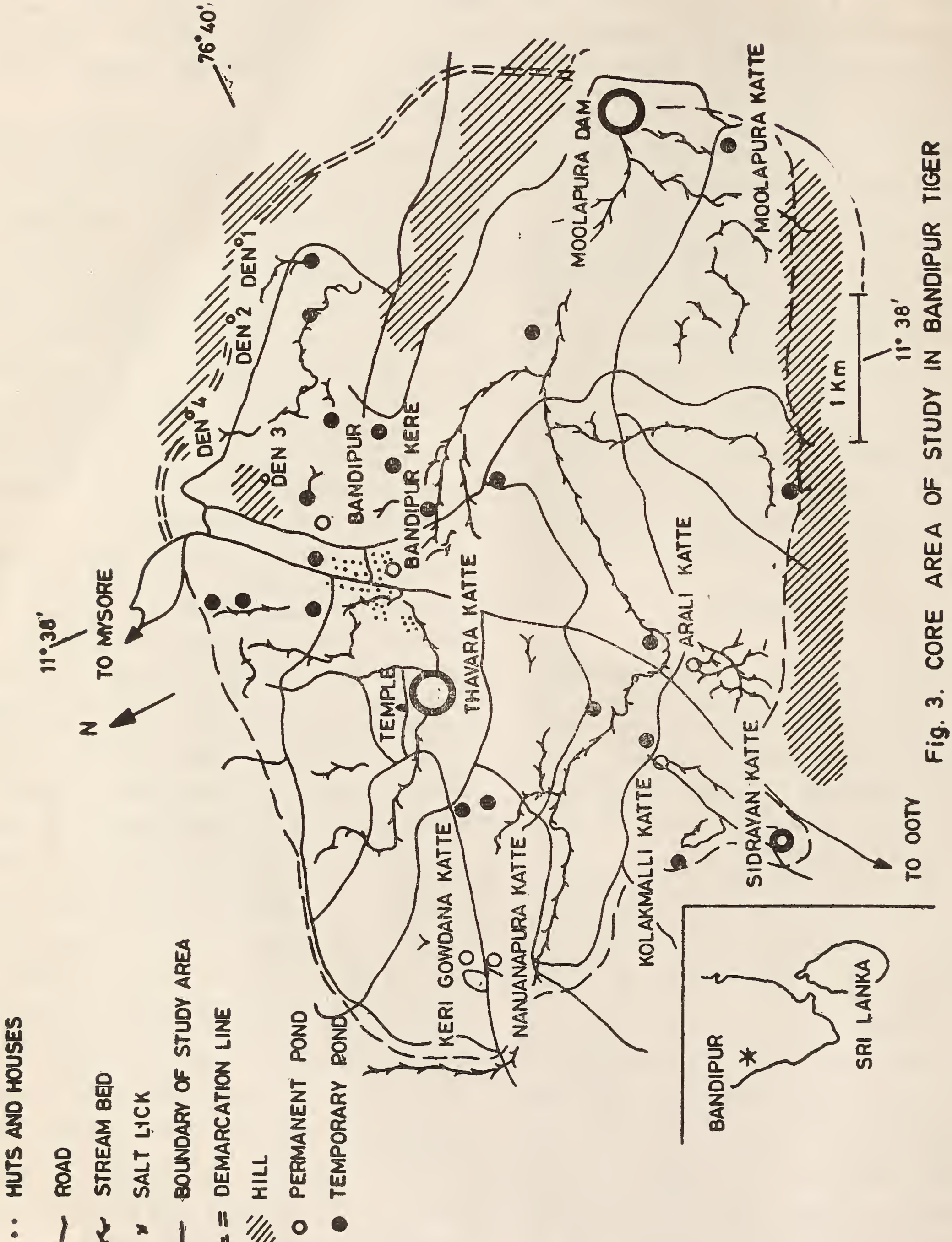
Bandipur, one of the 15 Tiger Reserves in India, offered an excellent opportunity to study the impact of dhole, leopard and tiger predation on chital and sambar (*Cervus unicolor*) and understand the ecological separation between a courser (dhole) and the stalking predators (leopard and tiger).

Because the study was carried out mainly on foot an area of 32 Km^2 was chosen around Bandipur (Fig. 2) and collection of kills, scats and prey censuses were restricted to the core area of the study pack, an area of 20 Km^2 (Fig. 3). Water in the study area was restricted to pools, some of which were perennial. Dense vegetation bordering pools and stream beds provided excellent cover for both ungulates and predators. The core area was divided into 219 quadrats for data analysis. In addition to the above mentioned animals the large mammal fauna in the Reserve included wild elephant (*Elephas maximus*), gaur (*Bos gaurus*), wild pig (*Sus scrofa*), muntjac (*Muntiacus muntjak*) and four horned antelope (*Tetracerus quadricornis*).

The vegetation was dry deciduous forest dominated by *Anogeissus latifolia* and *Tectona grandis.* Exotic weeds (*Lantana camara* and *Eupatorium glandulosum*) had established in many places. Bamboo (*Bambusa arundinacea* and *Dendrocalamus strictus*) regeneration was poor, after flowering in 1964 (Spillett 1966). Krishnan (1975a) gives a detailed account of the vegetation of Bandipur. The vegetation cover of the core area was classified into short grass scrub tree jungle (98 quadrats), scrub tree jungle (97 quadrats) and tall grass tree jungle (24 quadrats). Eleven of the 219 quadrats had permanent pools (Fig. 3).

Heavy premonsoon showers began in late April and May and the south west monsoon commenced in June and ended in August. The north east monsoon began in the later part of September and extended through November. Three seasons hot, wet and cool were distinguished (Neginhal 1974). The cool season started in November and lasted until mid February. During this period temperature seldom exceeded 25°C, relative humidity at noon was 70% and there was enough light to make field observations until 1800 h. Vegetation was green and dense after the retreat of the north east monsoon. Within a month, however, the grass turned yellow and began to seed. In January Forest department personnel burnt the road side grass and fire watchers patrolled the area during February, March and April.

The hot season commenced in late February and lasted until the middle of April. During March, the hottest month, temperature rose to 30°C even in shade and humidity was 42%. Sunset was around 1835 h. and there was sufficient light for field work until 1900 h.



HUTS AND HOUSES
ROAD
STREAM BED
SALT LICK
BOUNDARY OF STUDY AREA
DEMARCATION LINE
HILL
PERMANENT POND
TEMPORARY POND
76°40'
11°38'
11° 38'
N
TO MYSORE
TO OOTY
1 Km
DEN 1
DEN 2
DEN 3
DEN 4
BANDIPUR
BANDIPUR KERE
THAVARA KATTE
TEMPLE
MOOLAPURA DAM
MOOLAPURA KATTE
ARALI KATTE
SIDRAYAN KATTE
KOLAKMALLI KATTE
NANJANAPURA KATTE
KERI GOWDANA KATTE
BANDIPUR
SRI LANKA

Fig. 3. CORE AREA OF STUDY IN BANDIPUR TIGER RESERVE

The wet season was the longest, extending from May to October. The sky was overcast throughout, temperature seldom exceeded 27°C and humidity rarely went below 60%. From the beginning of April premonsoon clouds drifted across the study area and showers activated the emergence of winged termites (*Odontotermes* spp.) and swarms of butterflies.

METHODS

GENERAL

The study was conducted between 1st August 1976 and 13th December 1977 and 4th February 1978 and 31st July 1978. Two local tribesmen served as field assistants throughout the study. Working on foot afforded an excellent

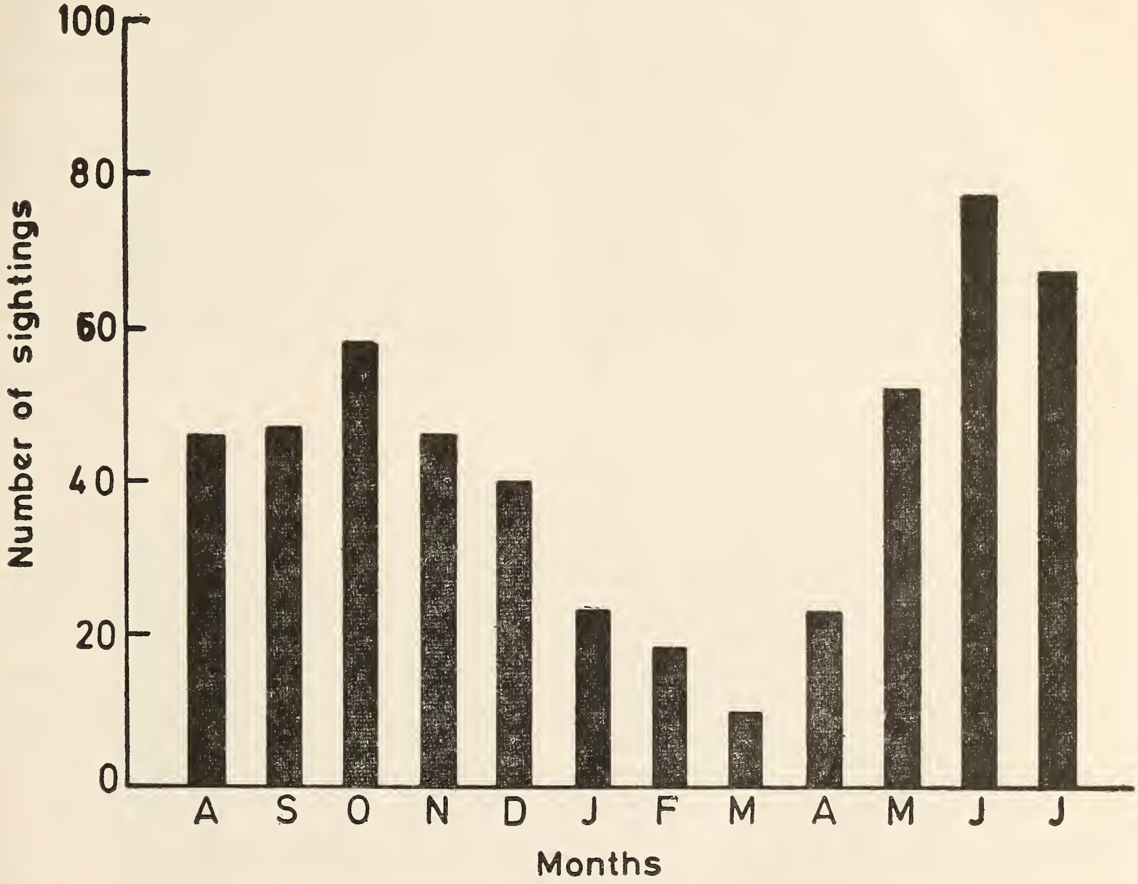


Fig. 4. Sightings of elephants, solitary as well as herd, from August 1976 to July 1977 (512 sightings).

opportunity to understand the terrain and its microhabitats but it imposed severe limitations on mobility. Elephants were common in the study area (Fig. 4) and their presence eliminated the possibility of working at night.

Twenty nine sites safe from elephants were used as observation points. The daily schedule began at 0630 h. when 3 observers went off in different directions looking for dholes. Observers stayed in one of the observation points or walked listening for the alarm calls of chital, sambar, common langur (*Presbytis entellus*), Peafowl (*Pavo cristatus*) and Grey jungle fowl (*Gallus sonneratii*). Jungle Crows (*Corvus macrorhynchos*) were of great help in locating kills. Fifty five per cent (n = 219) of fresh dhole kills, 72% (n = 58) of leopard kills and all (n = 19) tiger kills were located by observing crows. Tracking resumed again between 1500 h. and 1800 h. During the midday heat we searched the scrub for kills or remained in hides near water holes.

Whenever a prey species gave an alarm call we attempted to discover the cause when possible. For instance during the first year of study alarm calls of chital were heard 157 times, sambar 109 times and langur 56 times. Observations and indirect evidence helped to ascertain the reason only 12 times (8%) for chital alarms, 21 times (19%) for sambar alarms and 15 times (27%) for langur alarms. When alarm calls were recorded on the quadrats we acquired additional information on prey concentration and dispersion and preferred habitats of predators.

Whenever dholes were sighted we followed them at a distance of approximately 100 m. If a kill was made, the pack was approached as close as possible without detection, and while the pack was feeding it was possible to observe them for longer periods of time. The pack size, location, weather and time of day were recorded at each sighting. Tiger and leopard numbers were assessed on the basis of sightings, tracks and location of different fresh kills.

KILLS AND THEIR AGE ESTIMATION

In cases where direct observation was not possible the prey's wounds, tracks and trampled vegetation helped to determine the identity of the predator. Tiger kills were distinguished from leopard kills mainly by the tracks and hair seen around the kill.

Whenever possible kill remains were weighed to estimate amount of meat eaten. Lower jaws were collected and teeth were inspected for dental deformities. Size and condition (velvet or hard) of antlers were also recorded.

Eruption and wear of premolar and molar teeth was used to determine the relative age of prey. Chital were classified into 9 age categories (Schaller 1967) and sambar were classified as young fawns, large fawns, yearlings and adults. Fawns with erupting premolars were classified as young fawns. Fawns with fully erupted milk premolars were considered large fawns. Sambar fawns completely eaten by dholes were also included in the young fawn group.

Six chital carcasses were checked for ecto- and endoparasites. Lungs of 9 partly eaten chital and of 2 sambar fawns were checked for parasitic cysts.

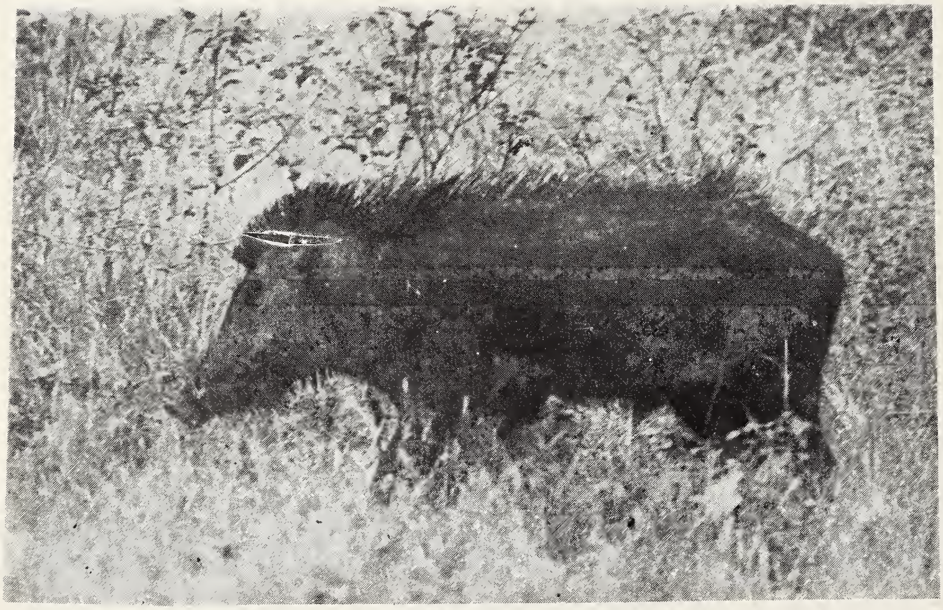
SCAT STUDY

Dholes use scats for marking their home ranges and one or two scats were, therefore, collected from latrine sites. It was assumed that fresh droppings represented the previous meal and I was thus able to investigate the sequence of kills.

A herd of chital in a pool in Bandipur.

Sambar leaving a pool.
(Photos: *Author*)

A gaur herd in Bandipur tree jungle.



Wild pig - dominant mammalian scavenger in Bandipur.
(Photos: *Author*)

Leopard and tiger defecate either on the central grassy strip of forest roads or on grass immediately bordering them. These areas were searched for scats.

The scats were later soaked in water and dissected thoroughly to separate hair, bones and other components. Hair samples donated by Bombay Natural History Society and those collected from kills were used as reference. Whenever identification was not possible with the naked eye a binocular microscope and the key by Koppikar and Sabnis (1976) were used.

Adult and fawn remains in scats were visually differentiated by the nature of the hair, presence of hooves teeth and digested calcium. Presence of soil and grass was taken into account if 50% or more of the droppings consisted of these items (Schaller 1967). When the remains of more than one species was found in a scat, all hair types were identified and all species that had contributed to the scat content were considered eaten by dholes. A total of 509 dhole, 70 leopard and 36 tiger scats were collected. Sixty seven scats of jungle cat

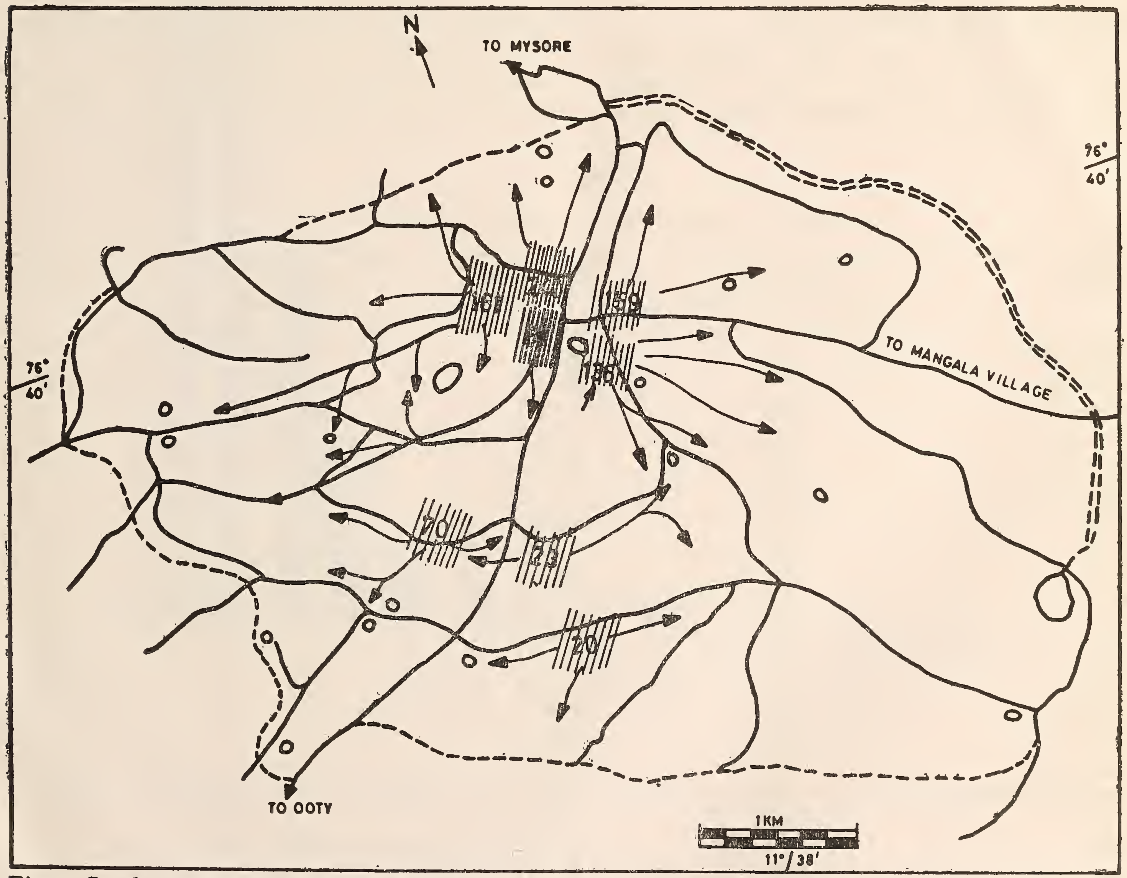


Fig. 5. Chital herds of Core area and directions of their foraging trips from their rest sites (July 1977).

(*Felis chaus*) and 86 of sloth bear were also analysed.

PREY DENSITY ESTIMATES

Population estimates of prey species were based on direct counts. In Bandipur from May to October chital formed large herds in certain parts of the core area (Fig. 5). In these months nearly 500 chital from Sommayanakatte, Mysore lodge pool and Huvinkatte came to Bandipur campus to spend the night. They were counted from trees near trails either when they came to the campus or left.

Chital in other areas were counted either from vehicles or from a distance with binoculars. Counting was difficult during the dry season when chital were dispersed. Chital were classified as adult ♂♂ in hard and velvet antlers, yearling ♂♂ with spike antlers, does and fawns (Table 2). Males in shed antler were included in the velvet group.

Accurate estimation of sambar numbers is difficult as they prefer dense cover and are solitary or found in small groups (Fig. 6). In undisturbed parts of the study area sambar were active during the day, but in disturbed areas they retired to cover at day break and emerged late in the evening. Sambar were counted and observed as they came out of cover in the evening to feed and when they returned to rest sites. From May to September sambar visited waterholes during the day time more frequently than in other months ($X^2 = 34.57$, d.f., 1,

TABLE 2

AGE AND SEX RATIOS OF CHITAL COUNTED IN THE CORE AREA

Month	Total number counted and classified	Spike/Stag	Total male/ Total female	Fawn/ Female
August, 1976	701	0.15:1	0.57:1	0.28:1
September	629	0.25:1	0.62:1	0.37:1
October	525	0.31:1	0.4 :1	0.38:1
November	708	0.42:1	0.63:1	0.42:1
December	510	0.24:1	0.47:1	0.39:1
January, 1977	508	0.25:1	0.68:1	0.44:1
February	504	0.20:1	0.59:1	0.42:1
March	521	0.24:1	0.74:1	0.60:1
April	643	0.47:1	0.52:1	0.53:1
May	740	0.32:1	0.81:1	0.70:1
June	910	0.28:1	0.77:1	0.66:1
July	857	0.32:1	0.93:1	0.67:1
August	935	0.51:1	0.69:1	0.58:1
September	801	0.39:1	0.85:1	0.53:1
October	619	0.51:1	0.85:1	0.44:1
November	756	0.49:1	0.84:1	0.42:1
February, 1978	332	0.28:1	0.49:1	0.29:1
March	361	0.09:1	0.51:1	0.33:1
April	872	0.53:1	0.62:1	0.49:1
May	1096	0.34:1	0.72:1	0.61:1
June	1114	0.33:1	0.81:1	0.60:1
July	1172	0.33:1	0.86:1	0.63:1

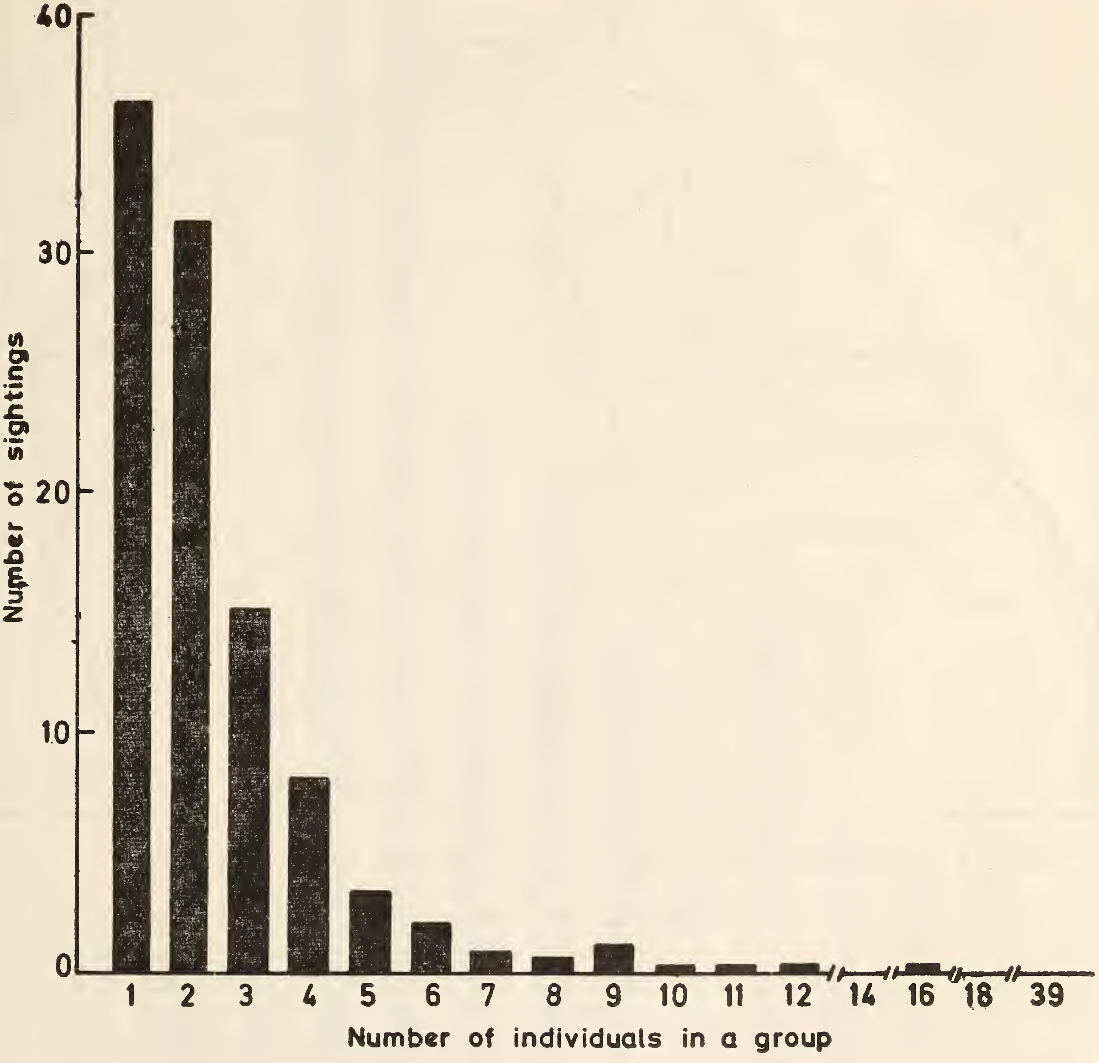


Fig. 6. Frequency of sightings of sambar groups of various sizes (Total 1995 sightings).

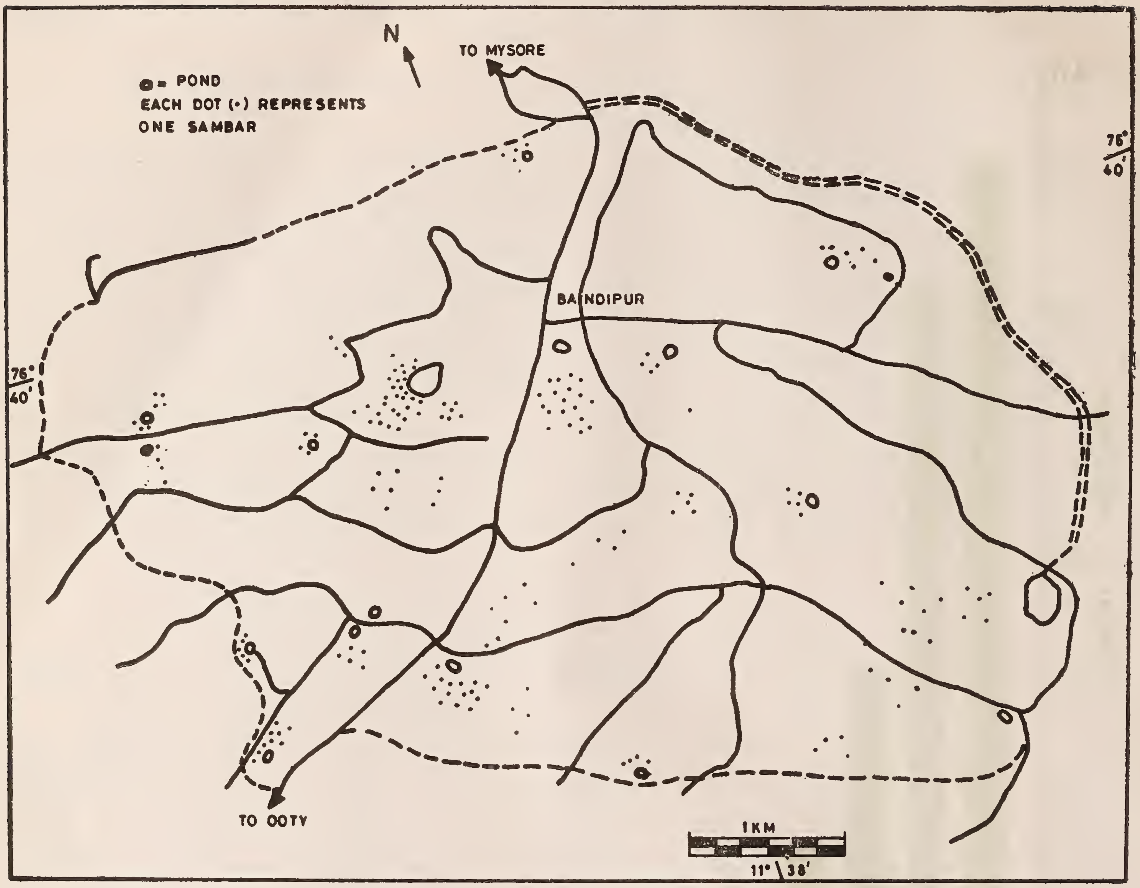


Fig. 7. Concentrations of sambar in the Core area during July 1977.

$P < 0.001$, Table 3). Preferred localities of sambar are marked in figure 7. Sambar were classified into adult ♂♂ in hard and velvet antlers, yearling ♂♂ with spike antlers, does and fawns (Table 4).

The abundance of other prey species including elephants, gaur, wild pig, muntjac, common langur, porcupine (*Hystrix indica*) and Black-naped hare (*Lepus nigricollis*) was also estimated. Peafowls were counted at roost sites.

A line transect study was carried out in other parts of the study area to document the abundance and seasonal migration of prey species. Eight 4000 m long transects were laid out at intervals of 600 to 800 m (Fig. 2). Every month from September 1976 to August 1977 ungulate counts were made from these transects. The study area was then divided into 27 sectors and sightings were recorded on the map. In addition a monthly watch was kept on waterholes between October 1976 and August 1977. Animals were counted as they came to drink between 0900 and 1600 h. two days each month (Table 3). Temperature, humidity and

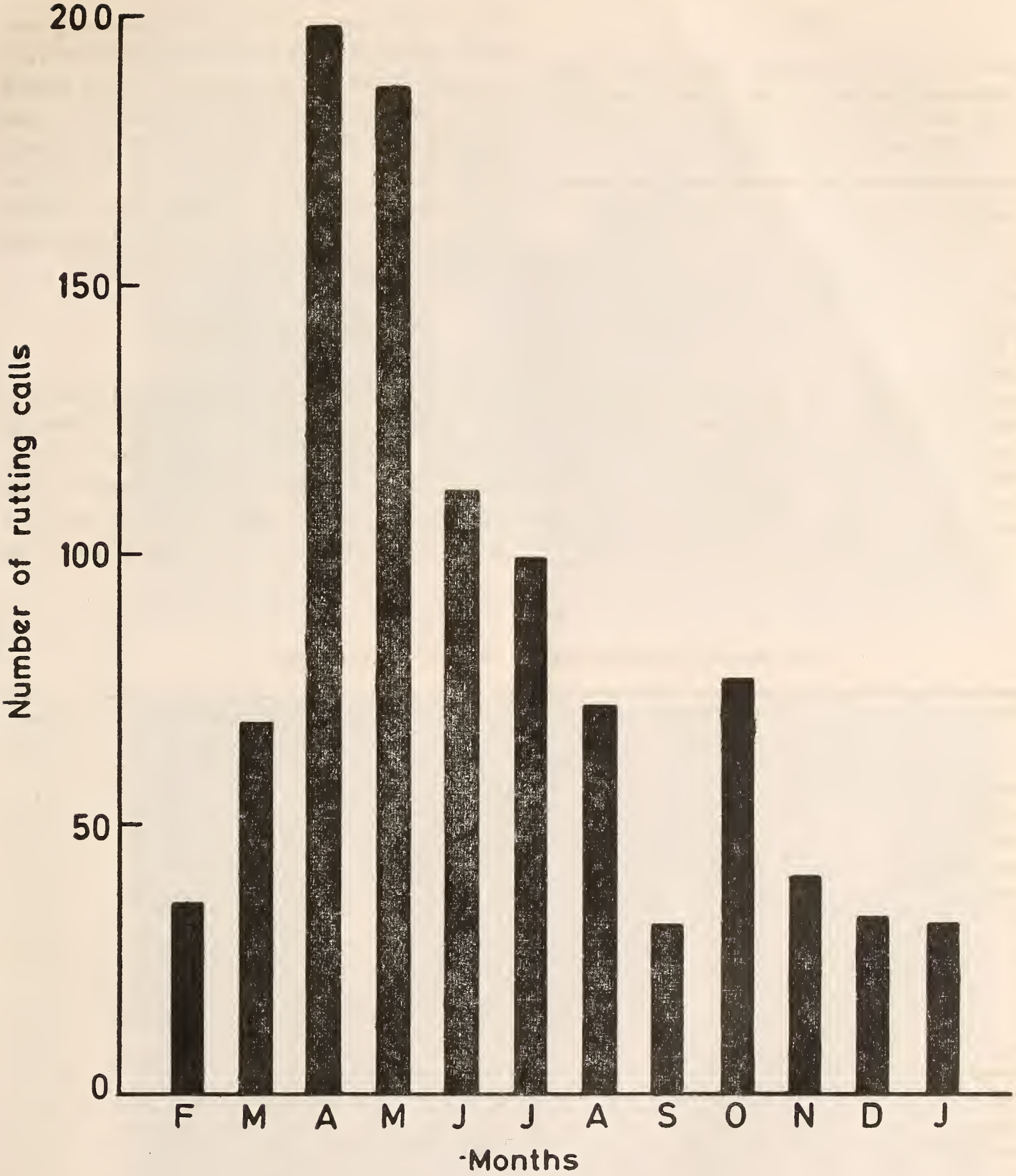


Fig. 8. The total number of rutting calls of chital stags heard daily between 0630 and 0930 h and between 1600 and 1830 h over the period February 1977 to January 1978.

TABLE 3

NUMBER OF LARGE MAMMALIAN HERBIVORES VISITED THE WATERHOLES DURING THE DRY SEASON (5 MONTHS) AND THE WET AND COOL SEASON (6 MONTHS) — (OCTOBER 1976 TO AUGUST 1977)

Wet and Cool Season		Dry Season	
Chital	20		284
Sambar	50		5
Muntjac	—		10
Wild pig	1		1
Langur	—		1
Maximum humidity	77	Maximum humidity	77
Minimum humidity	36.5	Minimum humidity	20
Maximum temperature	28.5°C	Maximum temperature	32°C
Minimum temperature	21°C	Minimum temperature	19°C

time of visit were recorded. Observation points were chosen in such a way that the observer's presence could not be detected. Chital rutting calls were counted between February 1977 and January 1978 (Fig. 8). Jungle cat (*Felis chaus*), jackal (*Canis aureus*), stripe necked mongoose (*Herpestes vitticollis*), Indian rock python (*Python molurus*) and Crested Hawk-Eagle (*Spizaetus cirrhatus*) were also observed.

BIOMASS ESTIMATION

While estimating the weight and biomass of the species the procedure largely following Schaller (1967, 1972) was adopted. In elephants, gaur, sambar and chital there is large variation in size of different sexes and sex ratio. The biomass was calculated based on

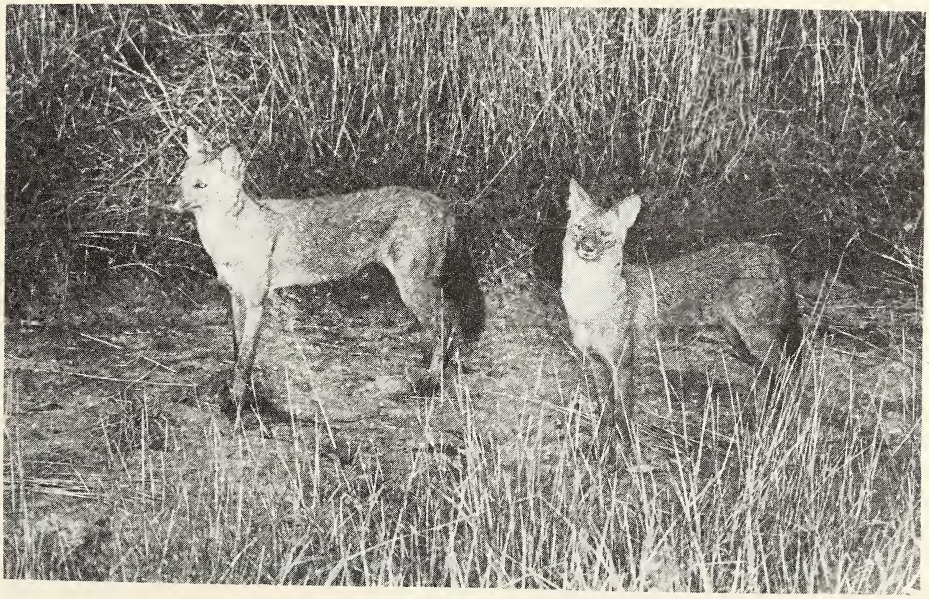
TABLE 4

AGE AND SEX RATIOS OF SAMBAR SEEN IN THE CORE AREA

Month	Total number classified	Spike/Stag	Total male/ Total female	Fawn/ Female
October, 1976	140	0.43:1	0.49:1	0.11:1
November	211	0.25:1	0.37:1	0.20:1
December	174	0.19:1	0.44:1	0.31:1
January, 1977	182	0.18:1	0.43:1	0.27:1
February	142	0.26:1	0.50:1	0.37:1
March	144	0.32:1	0.37:1	0.25:1
April	162	0.56:1	0.29:1	0.40:1
May	315	0.47:1	0.43:1	0.36:1
June	315	0.56:1	0.41:1	0.33:1
July	379	0.68:1	0.50:1	0.28:1
August	346	0.68:1	0.48:1	0.29:1
September	253	0.93:1	0.33:1	0.21:1
October	229	0.70:1	0.50:1	0.32:1
November	164	1 :1	0.33:1	0.25:1
February, 1978	56	2 :1	0.16:1	0.35:1
March	99	1.2 :1	0.33:1	0.30:1
April	161	0.76:1	0.29:1	0.26:1
May	263	0.36:1	0.34:1	0.35:1
June	448	0.42:1	0.24:1	0.43:1
July	254	1.10:1	0.34:1	0.44:1

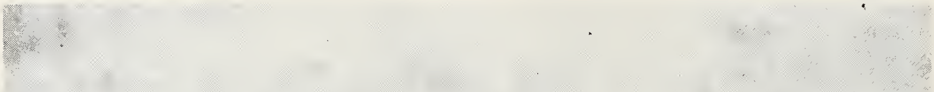
PLATE III

An elephant family group in Bandipur. The matriarch is drinking from a rock puddle.



Dholes have an excellent sense of smell.
Dhole on the right hand side tried to smell out the author's presence.
(Photos: *Author*)

Common langur was the prominent primate in Bandipur.



An alert pea hen. Peafowls are potential prey of large carnivores.
(Photos: *Author*)

the actual composition of the population. Weights of elephants were obtained from Mudumalai elephant camp (John Joseph pers. comm.) and for other animals data given in Prater (1971) were used. The biomass of langur, porcupine, hare and Peafowl was obtained by multiplying the three quarters of the weight of an adult ♀ by the number in the population. For pig and muntjac approximate minimum adult weight and number in the population was used. Since lone gaur bulls were mostly seen in the core area weight of an average sized bull was used.

PREY SPECIES

CHITAL

Density and population composition

Chital were the most common and conspicuous mammal of the study area. From May to October 857 to 900 chital congregated within a 7 to 8 Km² area around Bandipur and reached a density of 120/Km². These large herds fragmented at the onset of the dry season and formed bachelor herds, small groups of does and mixed parties. The dispersion of chital during the dry season may be influenced by a number of factors such as scarcity of green forage, availability of fruit and permanent water sources.

The movement pattern of chital in Bandipur (aggregation after rains) was different from that of Wilpattu where chital at the onset of rains dispersed from concentrations at selected villus (tank) toward villus which were dry during the drought (Eisenberg and Lockhart 1972). During the dry season it was estimated that nearly 800 chital remained in the core area, a dry season density of 40/Km². Density in Bandipur can be compared with the ecological density of 12.3/Km² in Bharatpur (Spillett 1967), 12/Km² in Wilpattu (Eisenberg and Lockhart 1972) and 17.3/Km² in Chitawan (Seidensticker 1976b). Extensive patches of short grass and dense thickets (fawning and escape cover) were the major reasons for the high density of chital in the core area.

Chital in Bandipur showed a sex ratio biased in favour of ♀♀ throughout the year. During the peak months of rut (1977 and 1978) the ♂ to ♀ ratio was 84:100. The highest fawn: doe ratio averaged for May, June and July 1977 was 68:100 and for the same period in 1978 the ratio was 61:100. In Bandipur 44% of the population was < 2 years old and for Kanha the figure was 53% (Schaller 1967).

Reproduction and peak in fawning

In Bandipur the peak rutting season was between April and July (Sharatchandra and Gadgil 1975 and Fig. 8). Extrapolating from the April to July rutting peak and assuming an 8 month gestation period (Schaller 1967) more fawns should have been seen from December to March. Young fawns, however, remained hidden during the early weeks and could only be reliably counted when they began to accompany the does. This occurred in May, June and July after the summer rains and sprouting of grass. Twin fawns were observed on 5 occasions.

Peak in fawning could be confirmed by distributing fawn kills, number of scats with fawn remains collected in Bandipur and fawn births recorded by Crandall (1964) over different months of the year (Fig. 9). In total 100 fawns killed by dholes, 11 by leopard and 1 by tiger were collected. Fawn remains were seen 143 times in dhole scats. Twenty five scats of leopard and 8 of tiger had fawn remains. When distributed over the year it was clear:

a) fawn kills showed a peak from February to July;

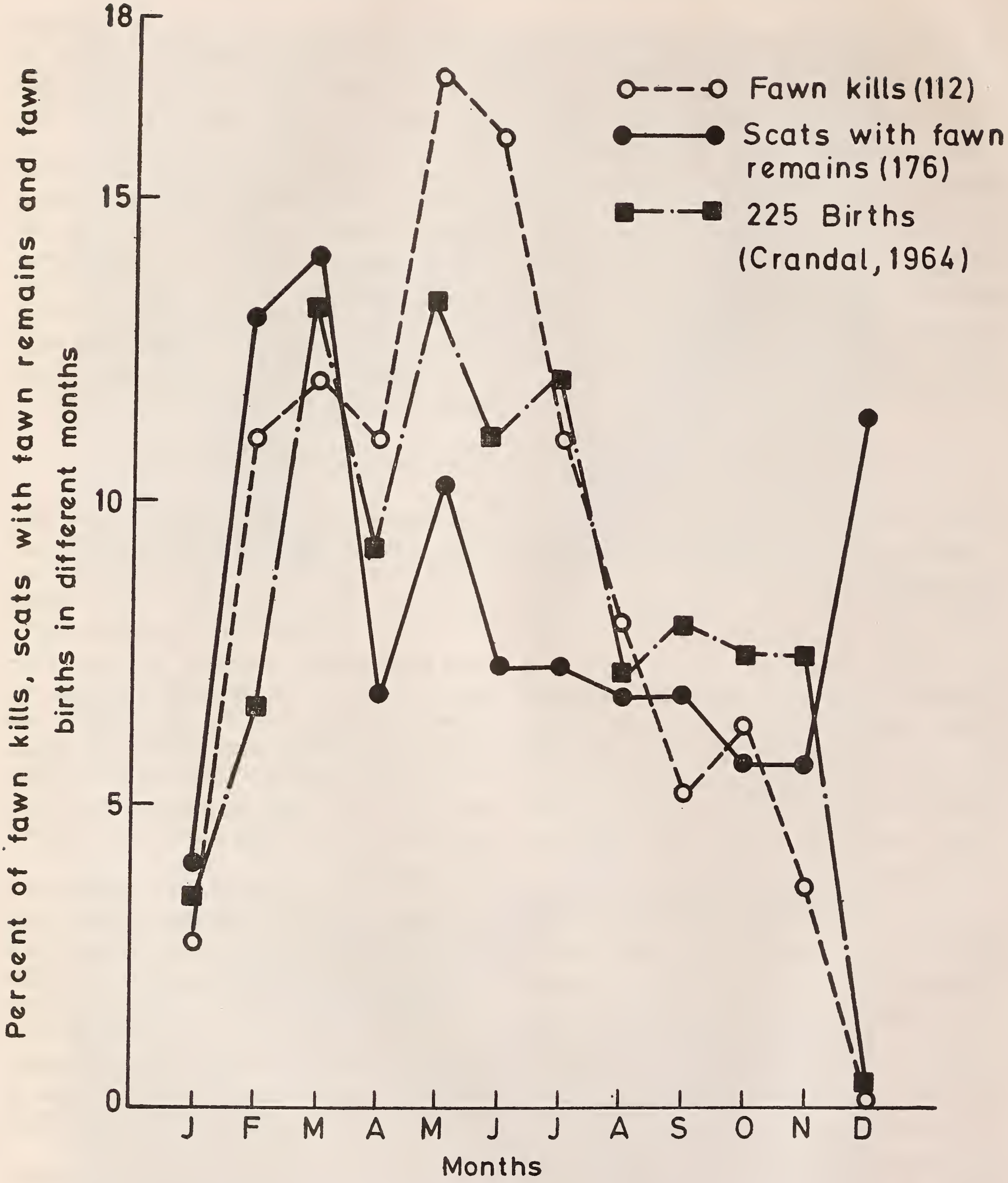


Fig. 9. Chital fawn kills, scats with fawn remains and birth of fawns in different months of the year.

b) scats with fawn remains were common in December, February and March;
c) birth of fawns showed a peak from March to July.

Young fawns are said to be scentless. (Brander 1927, Graf and Nicholas 1966). Scat analysis, however, showed that in December, February and March many fawns were killed than in other months ($X^2 = 25.885$, d.f., 1, $P < .100$). Pooled together the data indicated a fawning peak from December to March. Fawn sex ratio (Graf and Nicholas 1966, Schaller 1967, Acharjyo and Padhi 1972) indicates an even sex ratio at birth. Adult sex ratio however, favoured ♀♀ and this could be attributed to a higher mortality of ♂ fawns.

Mortality

Possible causes of mortality include accident, disease and predation. Two does and one stag were killed by vehicles. Deep wounds were frequently seen on rutting stags and one stag killed by dholes had a deep stab wound in the lower jaw. In May 1977 one stag was killed by another stag.

All chital examined had ticks (*Haemophysalis* spp) and flies (*Lipoptena* spp). Of the 13 checked for cysts, one young stag with 40 cm long hard antlers, had an infestation of 30 *Cysticercus* cysts in the lungs and a prime adult doe had 3 cysts and *Setaria* spp worms in its peritoneal cavity. Deformities which can affect feeding efficiency and lead to debility are listed in Table 5.

The major cause of mortality was predation. Chital accounted for 74% of the 379 kills by predators. An analysis of 509 dhole, 70 leopard and 36 tiger scats showed chital hair in 52%, 51% and 39% respectively.

Local people frequently stole kills of predators. This probably had a deleterious effect on chital population as predators were forced to make more kills. During August and September 1976 there were 18 dhole and 3 leopard kills of chital. All 3 leopard kills and 10 of the 18 dhole kills were stolen.

Antipredator behaviour

Chital have an excellent sense of smell and hearing but they often failed to dctect me at distances of 5 to 7 m when I sat and froze close to a tree. They were alerted by the alarm calls of other animals, and sensed the presence of dholes which were not noticed by me (see Appendix I, hunt 17). When attacked by dholes (e.g., hunt 9) even chital with long hard antlers fought ineffectively. Chital employed a variety of antipredator strategies including:

(a) Bunching: Chital were seen to bunch in the presence of dholes ($n = 16$) and in the presence of leopard ($n = 2$) and tiger ($n = 1$). Bunching was seen 17 times in wet and cool months.

Dholes were not observed to attack chital in a herd. The fear of being trampled and the inability to concentrate on a particular individual may deter dholes. Stags on seeing dholes moved either to the front or to the middle of the bunched fleeing herd. When 7 dholes went past a herd of nearly 100 chital the stags ran to the middle and 4 to 6 chital does with raised tails and stamping feet came forward to investigate. Once a leopard walked by and nearly 25 chital bunched and with raised tail sounding alarm and stamping their forefeet trailed at a distance of 40 to 50 m behind the cat, similar to an incident reported by Eisenberg (in Smythe 1970). The behaviour of the chital was like the curiosity behaviour reaction of hoofed mammals towards African predators (Kruuk 1972).

(b) Distraction display: Does with young fawns ran off and left the fawn on two occasions. A doe with a young fawn as soon as it

TABLE 5

DEFORMITIES SEEN IN CHITAL KILLED BY PREDATORS

Sl. No.	Date or month	Particulars of Prey, Sex, age class and antler length in cm.	Deformity	Predator
1.	August, 1976	♀, VIII	Exerstosis on the left maxilla on the medial aspect at the first molar level. Both the first molars not well developed.	Dhole
2.	March, 1977	♀, VIII	Differential wear. No wear on the first premolar and heavy wear on the last molar.	Dhole
3.	12 June, 1977	♀, VIII	Differential wear. First premolar was not worn down. Possibly the upper apposing molar was absent.	Leopard
4.	1 August, 1977	Stag, V, 82 cm hard antlers	Excess callus formation at the junction between the last maxilla and the maxillary symphysis probably due to a piercing wound.	Dhole
5.	20 August, 1977	♀, VIII	Differential wear on molars. First premolar and last crown of the 3rd molar were not worn down.	Leopard
6.	January, 1978	Stag, V, Velvet antlers eaten	Congenital maldevelopment (hypoplacia) of the first molar on the right maxilla	Dhole
7.	28 February, 1978	♀, VIII	Differential wear conspicuous on the second molar on the left maxilla.	Dhole
8.	14 April, 1978	♀, VIII	Exerstosis on the right maxilla. Maldevelopment of teeth except the last molars.	Dhole
9.	21 June, 1978	Stag, V, 18 cm hard	Left antler of the stag had broken and had healed when it was in velvet at a height of 50 cm.	Dhole
10.	3 July, 1978	Stag, IV, 45 cm hard	First crown of the last molar and the last crown of the second molar were broken. Left antler was broken at a height of 12 cm from the base.	Dhole
11.	11 July, 1978	Stag, V, 72 cm hard	Extra third premolars	Dhole

saw me, lay flat on the ground and kept the head level with the grass. When I approached her closer she rose, spronked, heavily thumped her forefeet and the fawn ran away.

(c) Remaining motionless in cover: Adult chital sometimes hid in dense cover when alarmed by dholes (n = 3). One doe, took refuge in a bamboo clump when chased and attacked by a village dog in Sigur an adjoining forest tract. Chital fawns were also found hiding in dense cover (n = 7) (Appendix I, hunt 18). When chital were surprised in the scrub they gave a startled call and dispersed abruptly in different directions. This may confuse a predator.

(d) Flight: Chital flight distance varied in different parts of the study area. Near Bandipur they could be approached to a distance of 30 m but in the more remote parts of the study area, where poaching occurred, flight distances in excess of 80 m were common. When directly approached by hunting dholes the flight distance was usually 60 m or more. When pursued by dholes chital fawns called in distress.

(e) Seeking refuge in water: On 4 occasions during the study chital stood at bay in water to escape dholes but all were killed. Chital twice ran across the river in Sigur when pursued by dholes, probably in an attempt to lose them. On another occasion a chital doe stood at bay in Sigur river to evade a village dog. Only our intervention saved the doe.

SAMBAR

Distribution

Sambar were the most widely distributed large prey species in the study area. Their distribution and abundance appear to be influenced by dense cover, water and by their ability to subsist on a wider variety of plants. During the wet and cool season cover was afforded by *Lantana* and bamboo while grass *Imperata arundinacea* under shady trees (e.g., *Shorea talura*) provided cover during the dry months. Rest sites near water were preferred. In contrast with chital sambar were found in hilly terrain (e.g., sectors 3 and 19) and tall grass (e.g., sectors 10 and 15).

Group size, density and biomass

Sambar in the study area formed large groups only at water holes and feeding sites. Otherwise single animals and groups of 2 formed 36% and 31% respectively of the 1995 sightings. An unusually large aggregation formed in response to a dhole pack; a total of 39 sambar (6 stags in hard, 4 in velvet, 3 spike bucks, 19 does and 17 fawns) was observed standing in a pond where they sought refuge. The population estimate for the core area in July 1977 was 160 to 180 or a density of 8 to 9/Km². This concentration was not seen during dry months when nearly 140 sambar stayed in the core area which gave a dry season density of 7/Km².

The high wet season density of sambar formed 13 to 14% of the total number of prey animals (excluding porcupine, hare and peafowl) and 36 to 38% of the prey biomass excluding elephant. The wet season density gave a total biomass of 24, 875 to 27, 984 Kg. or 1244 to 1399 kg/Km² (Table 6). The related figure from Wilpattu is 158 kg/Km² (Eisenberg and Lockhart 1972) and Chitawan 443 Kg/Km² (Seidensticker 1976b). The high density in the core area was mostly due to dense patches of escape cover (*Lantana* and bamboo) around water holes, which are distributed evenly in the core area.

Sex ratio

Sex ratio of sambar at birth appears to be even; of the 35 births recorded by Acharjyo

TABLE 6

POPULATION DENSITY AND BIOMASS OF MAJOR PREY SPECIES (EXCLUDING PORCUPINE, HARE AND PEAFOWL) AND ELEPHANTS IN THE CORE AREA — JULY 1977

Species	Estimate of numbers	Density per Km²	Average weight used in computation (in Kg.)	Total Biomass	Biomass per Km²
Chital	857— 900 ♂ 307, ♀ 330, yg 220	43—45	♂ 50, ♀ 40, yg 20	32950— 34603	1648— 1730
Sambar	160— 180 ♂ 45, ♀ 90, yg 25	8—9	♂ 225, ♀ 150, yg 50	24875— 27984	1244— 1399
Gaur	10± 10±	0.5—0.5	800	8000— 8000	400— 400
Wild Pig	50± 50±	2.5—2.5	30	1500— 1500	75— 75
Muntjac	20± 20±	1—1	15	300— 300	15— 15
Langur	150± 150±	7.5—7.5	8	68825— 73587	60— 60
Total	1247 1310	62—65.5		219200—219200	3441— 3679
Elephant	100± 15 Tuskers, 41 Cows, 35 Juveniles and 8 Calves	5	Tusker = 4000 Cow = 3000 Juvenile = 1000 Calf = 150		10960—10960
Total				288025—292787	14401—14639

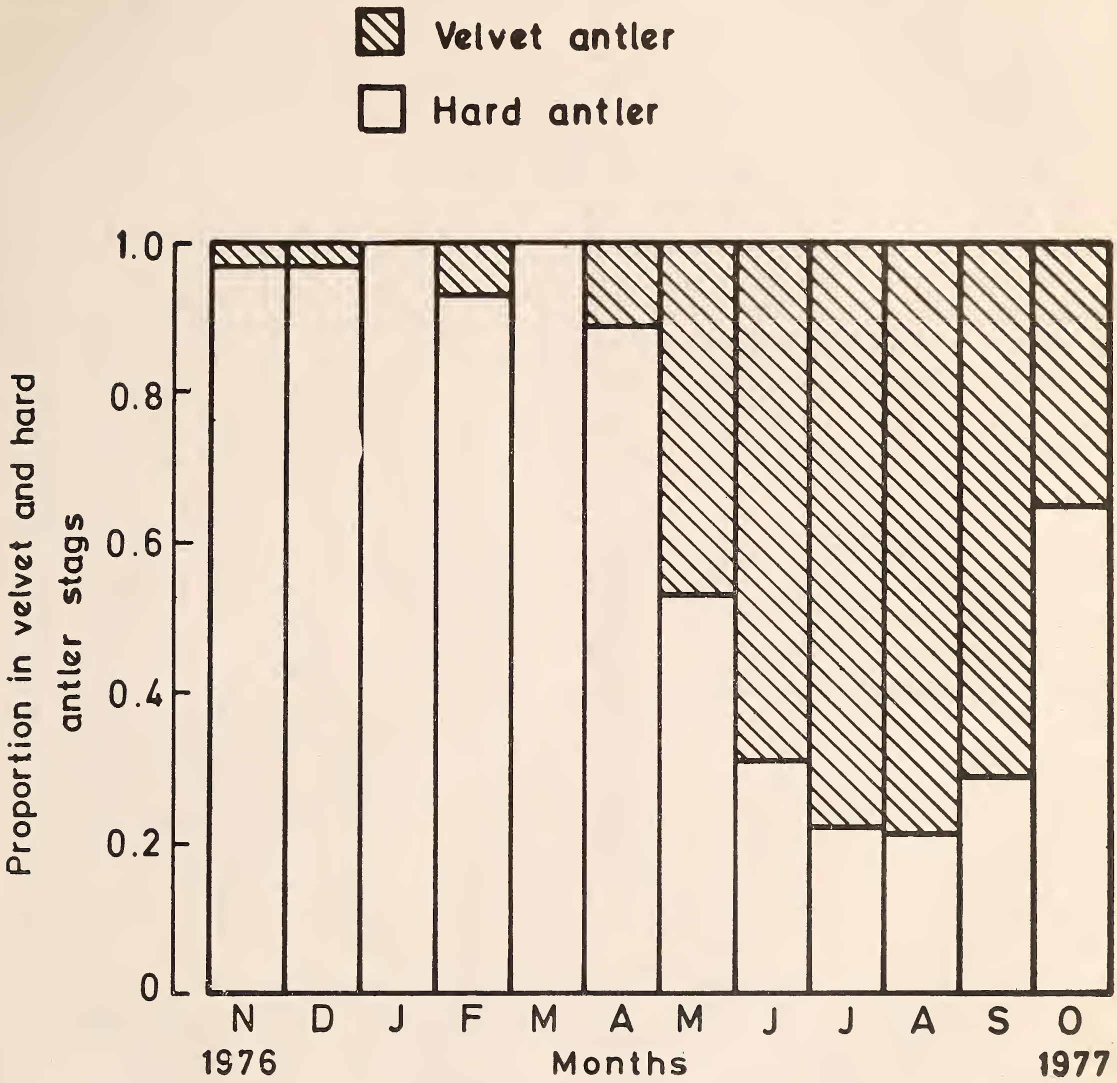


Fig. 10. The proportion of sambar stags in velvet and hard antlers.

and Padhi (1972) there were 14 ♂♂ and 21 ♀♀ or a ratio of 2:3. The null hypothesis that ♂ and ♀ sex ratio was even is acceptable ($Z = 1.645$, $P > .05$). Nevertheless the sex ratio showed a bias in favour of ♀♀ throughout the year (Table 4). Average ♂ to ♀ ratio during November, December and January was 41:100. Schaller sexed 11 kills and found the ratio of ♂ and ♀ to be 120:100 and ratio in the population was 30:100. Male kills were more common than expected ($X^2 = 11.46$, d.f., 1, $P < .005$). My data (see discussion: predation and sex of prey) and Schaller's confirm preferential predation on yearling and adult ♂♂.

Rut

In Bandipur sexual activity was indicated by antler development, sore patch, wallowing and courtship behaviour. Stags in hard antlers were observed mainly between November and April and most ♂♂ had shed their antlers by May (Fig. 10).

Fawning period

Sambar fawn population is difficult to estimate because they do not consistently follow the ♀♀ during the first 3 months (Eisenberg and Lockhart 1972). Lone resting fawns were flushed out of cover on 24 occasions (January, February and June each 3, March 4, April 5, May and August each 2 and November and December each once). This does not coincide with the beginning of rut (November) and may be the result of young fawns freezing in cover instead of running away when approached. Forty one kills of young sambar fawns (38 by dhole, 2 by leopard and 1 by tiger, Fig. 11) show that more fawns were killed from August to March than expected ($X^2 = 11.2$, d.f., 1, $P < 0.001$) which assuming an 8 month gestation period (Acharjyo and Misra 1971) indicated these fawns were conceived during the rutting season, November to April. Fawn to doe ratio averaged for May, June and July 1977 was 32:100 and for the same period in 1978 the ratio was 41:100.

Mortality

The major cause of observed mortality was predation. Of the 379 kills found in this study sambar accounted for 17%. Sambar remains were found in 14% of dhole ($n = 509$) and leopard scats ($n = 70$) and 31% of tiger scats ($n = 36$). Predation took a heavy toll of sambar fawns. Of the 66 sambar kills 41 (62%) were of fawns < 4 months of age. An examination of 93 predator scats with sambar remains (72 of dhole, 11 of tiger and 10 of leopard) showed 71 of them (76%) had sambar fawn remains. I removed 5 snares set for sambar.

Antipredator behaviour

Sambar have an excellent sense of smell but like chital they seem unable to distinguish immobile objects. Sambar have the ability to sense danger from the excitement created by the presence of a predator (hunt 3). The sambar's preference for dense cover may be an adaptation against dholes but could be disadvantageous when stalked either by tiger or leopard. Sambar do not have any white markings on their bodies which may be a cryptic adaptation for a life in the scrub. Sambar antipredator behaviour include:

(a) Watching: Schaller (1967) mentions the ability of sambar to remain motionless for long periods of time. This was observed many times and may enable them to remain unseen while investigating the movement of predators;

(b) Investigation of curious objects: When wind was not in their favour sambar were curious to know the identity of the object which

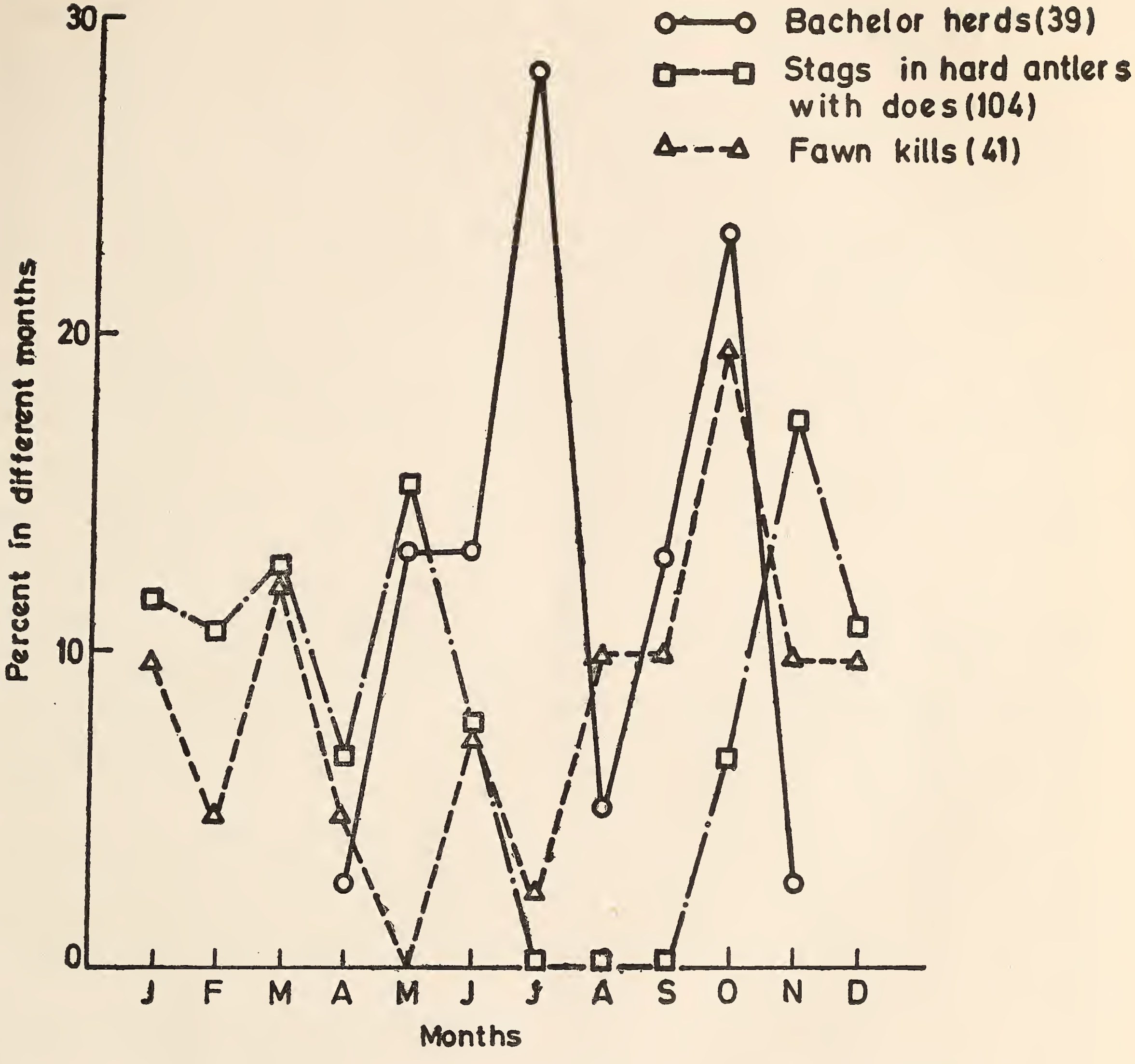


Fig. 11. Bachelor herds of sambar, stags in hard antlers with does and fawn kills seen over the period August 1976 to July 1978

attracted their attention. Once a sambar mistook me for a predator and keeping the tail vertical, thumping forelegs and jerking the head it approached me 7 to 10 m. A solitary adult tusker interrupted the observation. This type of curious approach may be advantageous if the stalking predator is forced to launch a preemptive attack;

(c) Belling: Sambar called when they saw predators including jungle cat. Their alarm calls varied in tone and intensity depending on the type of predator and whether or not it was hunting. When hunted by dholes sambar with young were not observed to call but adults without young did (hunt 6). When dholes hunted, ♀♀ with fawns were seen to leave the area (hunt 3). A leopard going through a scrub prompted a sambar to call in a subdued tone but the sambar did not run. Once 2 tigers killed a sambar doe in a patch of scrub and their movements were indicated by sambar alarms from the same scrub. It appeared that for the 2 days the tigers remained in the scrub the sambar of that area were not unduly disturbed. But on 6 different occasions when a tiger was hunting in the same scrub 1 to 14 sambar emerged giving alarm calls. Probably on these occasions the tiger was hunting;

(d) Remaining motionless in cover: Brander (1927) noted that sambar squat like a hare so they would be passed undetected. Once a fawn and another time a stag stayed in cover allthrough aware of my approach. The fawn placed its chin on the ground and lay crouched until I passed 5 m of it. The stag remained motionless until I was within 8 m;

(e) Seeking refuge in water: This was the most common and successful strategy against dholes and was seen 15 times. On 6 occasions sambar ran over a 3 m high tank bund to get into water. On 2 occasions they ran through scrub to get into 6 to 7 m wide puddle. While in the water sambar seemed to have control over the situation. Together an adult and a yearling doe successfully kept off the study pack from a fawn (hunt 21). While in water sambar kept their rumps together as moose (*Alces alces*) do (Mech 1966) (hunts 20 and 21). They also rose on their hind feet and struck at dholes with forefeet (hunt 20). The fear of being chased again often forced sambar to stay in water even after the dholes left (hunt 21). In Bandipur dholes did not press home their attack when sambar retreated to water (hunt 21) as chital were the main prey species;

(f) Attack: On land sambar were not able to protect their fawns successfully from dholes (hunts 5, 16, 17 and 19). But on 3 occasions in open areas adult sambar chased dholes — on two occasions solitary does chased 3 to 5 dholes and another time 2 does, watched by 2 yearling does, drove off 3 dholes (e.g., hunt 19). When sambar faced dholes on land they bristled their body hair, held their tails vertical laid back the pinnae and exposed the white of the eyes. Snorting was also heard. While approaching dholes they kept the head low to the ground extended the neck and stamped their forefeet.

On two occasions sambar fawns screamed when chased by dholes even though not physically assaulted (hunt 20 and 21). When chased by dholes sambar did not enter Bandipur village as was done by chital on 6 occasions.

ECOLOGICAL ADAPTATIONS OF BREEDING IN CHITAL AND SAMBAR

Continued optimal season is seen in tropics and equatorial regions where the seasons vary so little that young may be born at any time of the year and have an approximately equal chance of survival (Sadleir 1969). Although Bandipur is a tropical monsoon forest its environment has seasonality in food availability which presents a situation some what similar to the 'fixed optimal season found in temperate areas' (Sadleir 1969).

In Bandipur food for ungulates was scarce and was of low nutritional value from January to April. Grass was tender and green from May to August. Chital fawns, however, were born even in very dry months. Although chital fawns nibble grass when they are a week old they begin eating it in quantity by 5 weeks (Graf and Nicholas 1966). By the time many chital fawns were weaned and had greater food requirements the fodder condition had dramatically improved which enabled them to feed exclusively on grass.

A continued supply of tender grass from May to August would also enhance the development of the embryo conceived at the end of April. Further more the arrival of the north east monsoon by the end of September and the sprouting of more grass in October may provide the embryo with all essential nutrients. Thus at Bandipur chital are finely adapted to their environment by evolving weaning and pregnancy to synchronize with the time of abundant growth of grass.

In sambar rut commenced after the end of the May to September aggregation. Assemblage before the rut could lead to the formation of new breeding herds, social order and exchange of gene pool. Sambar hinds conceiving between November end and the beginning of May may have nutritional difficulties. The ability of sambar to eat a wide spectrum of forage, however, may nullify this hardship. Sambar fawns born in dry months have thin vegetation cover but their ability to remain hidden may help them overcome this difficulty.

WILD PIG

There were 155 sightings of sounders and solitary ♂♂. Lone ♂♂ were seen 81 times (53%) and the largest group had 32 (8 adults and 24 young). Of the 155 sightings 123 (79%) were seen in wet and cool months and 32 (21%) during the dry season. Pigs may be mostly nocturnal in their activity during the dry months.

The estimated number of pigs in the core area in July 1977 was 50 animals, a density of 2.5/Km². Stripers (young piglets) were seen in the months of June, July and August which implies littering after rains in May.

Wild pigs were the major terrestrial scavengers of the area. Five times they were seen eating the kill remains of dhole; three times in the presence of the pack (Johnsingh 1978). A chital fawn killed by a leopard and a chital doe killed by a tiger were also scavenged.

TABLE 7

FREQUENCY OF OCCURRENCE OF FOOD ITEMS IN 509 DHOLE SCATS COLLECTED IN BANDIPUR

Food Item	No. of scats with the remains of	Percent	No. of times with the remains of	Percent
Chital adult	126	24.75	127	23.87
Chital fawn	138	27.11	143	26.88
Hare	71	13.95	74	13.91
Sambar adult	16	3.14	18	3.38
Sambar fawn	54	10.6	54	10.15
Microtine Rodents	31	6.09	34	6.39
Cattle	14	2.75	14	2.63
Muntjac	8	1.57	8	1.50
Langur	6	1.18	6	1.13
Wild pig	4	0.79	5	0.94
Gaur calf	1	0.2	1	0.19
Beetle	5	0.98	13	2.44
Grass	35	6.88	35	6.58
Total	509	100	532	100

TABLE 8

SIGHTINGS OF WILD PIG, GAUR* AND MUNTJAC CORRELATED WITH RAINFALL

	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Wild Pig	7	4	8	9	27	17	28	16	14	10	11	4
Gaur	1	0	0	0	9	7	6	11	9	3	1	1
Muntjac	9	9	18	17	0	1	4	7	7	4	2	8
Average of the 3 years' rainfall	0	15.95	20.2	143.18	100.41	88.82	192.55	175.12	252.4	218.3	136.85	5.4

* sightings of groups and solitary bulls.

Daniel (1967) suggests that pigs may kill and eat fawns but this was not observed during this study.

Only 5 pig kills were collected. Four of these were adult boars killed by tigers and one was an unsexed adult killed by dholes. This latter pig had attempted to escape the dholes by backing into a pit and facing the dholes. Pig remains were seen in 6% of tiger scats (Fig. 12) and 1% of dhole scats (Table 7).

GAUR

Gaur was one of the most common large mammals of Bandipur before the 1968 rinder pest epidemic. During the study there were 48 sightings of gaur; lone bulls were seen 25 times (52%). The largest herd consisted of 45 to 60 animals. It was not possible to classify the animals with regard to sex except that mature bulls were black and females and young bulls were brown. Six herds were classified and within these there were 19 black adults (22%), 43 brown adults (51%) and 23 young (27%). There is a positive correlation (+569) between the number of sightings of gaur and rainfall (Table 8). Nearly 96% of gaur sightings were in wet and cool months.

MUNTJAC

This deer was not seen close to human habitation and its habitat was more often shared by sambar than by chital. In total 86 animals were seen belonging to 66 groups. Six animals could not be sexed. The rest were classified as 25 ♂♂ (31%), 39 ♀♀ (49%) and 16 young (20%). The sex ratio was 64 ♂♂ : 100 ♀♀. Of the 66 groups solitary animals were seen 50 times (76%) groups of 2 12 times (18%) and groups of 3 or 4 4 times (6%).

TABLE 9

GROUP SIZE OF ELEPHANTS COUNTED IN THE CORE AREA — AUGUST 1976 — JULY 1977

	August	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July
Total groups seen	12	23	25	18	27	18	15	6	7	19	24	35
Av. group size	5.9	9.8	12.5	7	8.7	8.5	6.05	6.8	6.3	5.78	7.87	9.7
Range	4–10	2–36	2–29	2–37	2–26	2–28	2–14	3–9	3–11	2–11	2–39	2–14

Muntjac showed a distinct movement pattern in relation to rain. Sixty one (71%) animals were seen during dry months when water was restricted to certain ponds. An estimate of 20 animals for the core area gave a density of 1 animal/Km^2.

No muntjac kill was collected ; 3% of leopard, 3% of tiger and 2% of dhole scats had muntjac remains in them.

Porcupine

Tracks and droppings of porcupine were commonly seen. The estimate for the core area was 100 animals, a density of 5/Km^2. Signs indicated that they centered their activities around water holes in summer. Six per cent of tiger and 1% of leopard scats had porcupine remains.

Hare and Rodents

The number of black naped hare was assessed to be 200 animals for the core area or a density of 10/Km^2. Fourteen per cent of dhole, 11% of leopard, 10% of jungle cat and 3% of tiger scats had hare remains. Crested Hawk Eagles were seen eating hare three times and once a hare, to escape the aerial attacks of a Crested Serpent Eagle (*Spilornis cheela*), abruptly crouched 3 times. Rodents were found in 64% of jungle cat, 14% of leopard and 6% of dhole scats.

Elephants

Elephant was not a common prey animal but its contribution to the biomass was significant. During the first year 2283 sightings were classified: adult tuskers 18%, juvenile tuskers 11%, Cows 40%, juvenile cows 17% and calves 15%. Mean group size between November and April varied between 6 and 8.7 and for May to October it was between 5.8 and 12.5 (Table 9). During the wet and cool season there were nearly 100 elephants in the core area and for the dry season the estimate was around 20. One calf was killed and eaten by a tiger. A leopard was chased by an adult tusker and dholes were chased 8 times.

Peafowl

This potential prey was restricted to the core area and there were nearly 180 birds. The sex ratio in the population was biased in favour of males throughout the year. In April, a month prior to the active breeding season, the ratio was 224 ♂♂ : 100 ♀♀. This can be compared with the ratio of 47 ♂♂ : 100 ♀♀ at Injar (Johnsingh and Murali 1980).

Peahens lay 3 to 5 eggs (Ali 1972) and in Bandipur chick mortality was high. Of the 27 broods seen 8% had 1 chick, 48% 2 chicks, 22% 3, 19% 4 and 4% had 5. Five kills (2 ♂♂ with trains, 1 ♂ without, 1 ♀ and 1 chick) were collected. Crested Hawk Eagles killed all 3 ♂♂ and a jungle cat killed the chick. Many brooding females killed in the scrub may go unnoticed.

ANTIPREDATOR BEHAVIOUR OF PREY SPECIES

The response of the prey species to the predator depends on the activities of the predator. If the predator is not hunting and happens to go past the prey the latter becomes alert, curious, and subdued alarm calls may be produced. When the predator is hunting the response entirely changes and any one of the following strategies — hiding in cover, flight or attack may be adopted. In general the antipredator behaviour is influenced by the size. habitat, sex, reproductive condition, sociability of the prey and size of the predator. Eisenberg and Mckay (1974) give a detailed sequence of events and their alternatives which may be followed by a terrestrial herbivore upon perceiving a predator. Table 10 summarizes the various antipredator behaviours seen in Bandipur. Certain antipredator behaviour are discussed further.

Bunching

Gregarious behaviour is a form of cover seeking in which an animal tries to reduce its chance of being caught by a predator (Hamilton 1971). Bunching of chital in the presence of dhole was first reported by Sharatchandra and Gadgil (1975). Reproductive investment of chital ♂♂ (sperms) is insignificant when compared with those of ♀♀ which carry the embryo for 8 months and nurse the fawn for 3 to 4 months. This high reproductive investment may prompt the ♀♀ to come forward and investigate the danger while the ♂♂ run to the safety of the middle of the herd. Bunching was seen in truly social mammals such as wild pig, gaur and elephants.

Remaining motionless in cover

This is an excellent means of escape for small animals and was often shown by hare and occasionally by chital. Sweeny *et al.* (1971) observed this in white tailed deer (*Odocoileus virginianus*) when chased by dog (*Canis familiaris*) and call this behaviour 'holding'. Older black-tailed stag (*Odocoileus hemionus*) remain bedded to escape hunters (Dasmann and Taber 1956). Interestingly this behaviour was shown by the much larger sambar. If sambar remains bedded when a predator approaches the bush down wind there is every chance the deer, whose dark brown coat blends well with the dim interior of the scrub, may escape unnoticed.

TABLE 10

ANTIPREDATOR BEHAVIOUR SEEN IN BANDIPUR

Species	Preferred habitat	Watching	Curiosity attraction	Bunching	Alarm Call	Distraction display	Tail flashing	Flight	Distress Call in flight	Abrupt crouching while running	Staying motionless in cover	Abrupt dispersion	Startling call	Deposition of pedal gland secretion	Seeking refuge in water	Attack
Hare	Scrub short grass	+	?	—	?	?	+	+	+	+	+	—	—	—	—	—
Muntjac	Forests with dense under growth	+	+	—	+	?	+	+	+	?	+	—	—	?	—	+
Chital	Scrub – short grass ecotone	+	+	+	+	+	+	+	+	?	+	+	+	+	+	—
Sambar	Scrub forest, tall grass	+	+	+	+	+	—	+	+	—	+	+	+	?	+	+
Wild pig	Scrub forest and short grass with water	+	+	+	Grunt	—	—	+	+	—	—	+	+	?	—	+
Gaur	Forest, grass land	+	+	+	Snort	—	—	+	—	—	—	—	—	—	—	+
Elephant	Scrub forest, grass land	+	+	+	?	—	—	+	—	—	—	—	—	—	—	+

+ = Present; — = Absent; ? = Unknown.

Alarm calls

Kin selection (Hamilton 1964, Maynard Smith 1965) and individual selection (Trivers 1971) have been evoked as two explanations for the evolution of alarm calls. Yahner (1980) discusses the functions and adaptiveness of barking in muntjac. Alarm calls of chital in the presence of a stalking predator may be a 'pursuit invitation signal' (Smythe 1977). Though chital form social groups late prenatal and early post natal care of the young rests only with the individual does and in that type of situation alarm calls may have evolved through individual selection. This is more so in sambar.

Through direct and indirect evidence many a time I recorded chital calling in the presence of leopard and tiger but never I saw chital calling when they clearly saw dholes. A stalking predator could be dangerous only at close quarters and repeated alarms could be given while the distance between them is sufficiently large for a reasonable chance for chital's escape if the stalking predator is hunting. This may not be the case with dholes. When dholes ran through the scrub chital gave subdued single alarms. Presumably the deer did not identify the predator.

Seeking refuge in water

Burton (1940) suggested that water is not a place of refuge and the habit of animals running to water or being killed near water is the result of their down hill race which accidentally takes them to water. Observations in Bandipur indicate that sambar purposely ran to water. A study of 9 kills including those of 5 adults (e.g., hunt 3) showed that certain prerequisites are necessary for this tactic to be successful:

(a) Water should be shallow enough to allow sambar to use forelegs powerfully;

(b) Water should not be too shallow which would permit dholes to walk in and attack;

(c) It would be better for sambar if there is scrub bordering the edge of water not affording space for the intercepting dholes.

Attacks

Wild pig, sambar, gaur and elephant actively chased dholes. Muntjac are said to attack and kill domestic dogs *Canis familiaris* (Hoogerwerf 1970). If the size of the prey determines the capability to attack then chital which are larger than muntjac and wild pig should attack. Horns and tusks evolved primarily as the weapons for the fight between the members of the same species rather than as defence against predators (Geist 1966). Chital is another example for this speculation. Probably shorter weapons like the canines of muntjac and pig can be effectively used against a predator than a longer antler. Sheer size of gaur and elephants enable them to intimidate dholes. Observations of sambar does and gaur cows chasing dholes in the presence of their young support the hypothesis that 'chasing predators may give naive prey individuals the opportunity to learn to recognize predators by participating in low risk chases' (Kruuk 1972, Berger 1979).

BIOMASS

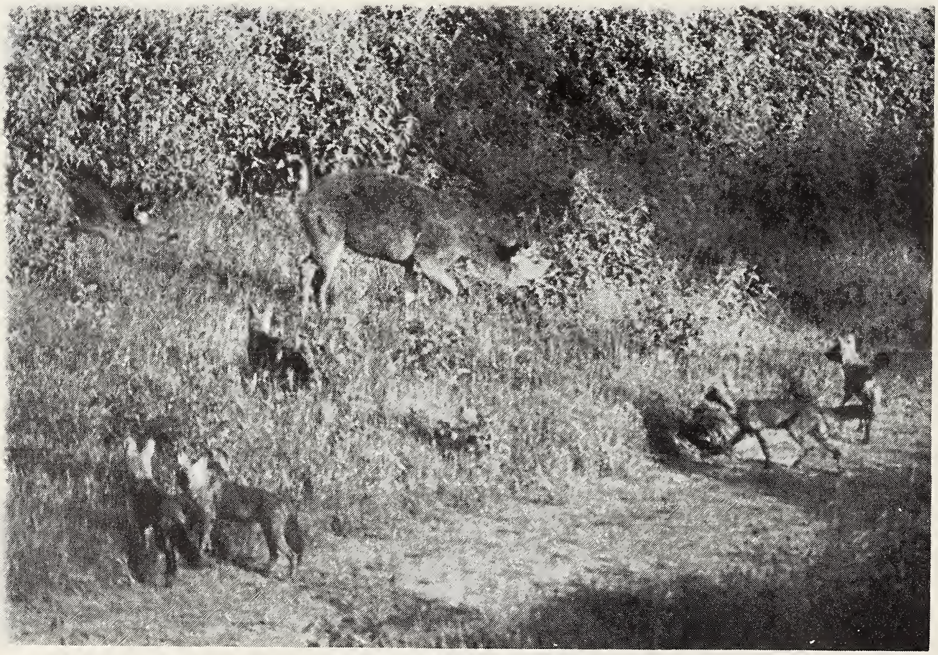
For understanding the effect of predation a calculation of biomass is necessary. The first attempt to estimate the biomass in the oriental region was made by Schaller and Spillett (1966) for the Keoladeo Ghana Sanctuary. Recently Eisenberg and Seidensticker (1976) reviewed the data on ungulate communities and their biomass in the Indian subcontinent.

In Bandipur if the contribution of other small

Leopard was the second common predator in Bandipur.

A young tiger in Bandipur
(Photos: *Author*)

Jackal was rare in the study area.



Sambar-dhole interaction.
(Photos: *Author*)

prey species such as porcupine (8 × 100 = 800 Kg.), hare (2 × 200 = 400 Kg.) and peafowl (3 × 180 = 540 Kg.) was added to the figure derived in Table 6 the biomass of prey animals was between (68,825 + 1740) 70,565 Kg. and (73,587 + 1740) 75327 Kg. or 3528 Kg. to 3766 Kg/Km². The average was 3647 Kg/Km². With the contribution of elephants the biomass ranged between 289,765 and 294,527 Kg. or 14,488 to 14,726 Kg/Km². The average was 14,607 Kg/Km².

This biomass was maintained almost throughout the wet and cool season. During the dry season owing to the dispersal of chital and sambar and the absence of gaur the prey biomass went down to 2863 Kg/Km². The prey biomass for dry months (2863 × 5 = 14,315) and for wet and cool seasons (3647 × 7 = 25,525) gave an average of 3,320 Kg/Km² for the year. In dry season hardly 20 elephants remained in the core area and their biomass (2,192 Kg/Km² with prey biomass 2,863 Kg/Km²) gave 5055 Kg/Km² which was 35% of the average biomass of the wet and cool season (14,607 Kg/Km²).

Another aspect of the study of biomass concerns the relative proportions contributed by the different species in the community (Mckay and Eisenberg 1974). In the core area during the wet and cool season numerically less and highly mobile elephants formed 76% of the total biomass, chital 11% and sambar 9%. The prey biomass of the core area is much higher than the biomass of 465 Kg/Km² for the entire Reserve (calculated from Wesley 1977). Major reasons for the core area having a high prey biomass were evenly distributed water holes and heterogeneous vegetation which afforded forage, escape cover and rest and fawning sites.

PREDATORS

NUMBER AND DENSITIES

In the core area there was a pack of dholes varying in number between 7 and 18 giving a density between 0.35 and 0.9 dholes/Km². Mean number of adults was 8.3; when pups were present the mean number was 16. Dholes were the major predators and accounted for 80% of the kills (n = 379). Two or 3 leopards and at least a ♂ and a ♀ tiger hunted in the core area. Leopards accounted for 15% of the kills and tigers for 5%.

HUNTING HABITS OF DHOLES

Time of hunt

The exact time was recorded for 124 kills made in the morning. Of these 96 (77%) were made after sunrise and 28 (23%) before sunrise. Of 67 kills in the evening 52 (78%) were seen before sunset and 15 (22%) after sunset. Three kills were made at different nights (e.g., hunt 11) of which 2 nights were moonlit.

Prelude to hunt

When prelude to the hunt was observed (4 instances) the dholes rested and played on roads and on 3 occasions near their defecation sites. While resting close to one another they nuzzled and rubbed their bodies together. Active submission, tail wagging, chase and ambush were common. Mounting was noted once. On 3 occasions some dholes playfully walked on branches of fallen trees. Once this peaceful get together suddenly gave way to vigorous play which abruptly subsided as the pack started off to hunt. Vocalization at the climax of play, reported in *Lycaon* (Estes and Goddard 1967) and in wolves (Mech 1970) was not heard.

At the beginning of the hunt dholes often moved in single file and the trotting speed was around 9 km/hr. Occasionally one or two dholes lagged behind sniffing a tuft of grass, lapping water or scavenging a bone.

Locating prey

Dholes have an excellent sense of smell and were able to locate the observer more than 100 m away (hunt 12). Dholes located prey by sight but they also depended on smell (hunts 3, 4, 8 and 12). In scrub where visibility was limited they primarily depended on smell. When the prey ran sight and hearing aided them to follow the quarry. Running sounds of prey in the scrub informed other dholes of the progress of the hunt. In one case 6 or 7 dholes approached a herd of gaur by stalking through the tall grass.

Dholes adopted two hunting strategies. In one strategy they moved through the scrub in an extended line formation (e.g., hunts 5, 8, 16, 18, 19 and 24) and any adult may begin the attack when it locates prey. In the other strategy some pack members remained at the periphery of the scrub to intercept fleeing prey as it was flushed (e.g., hunts 1 to 5, 15 and 19). Both formations are effective for locating hidden fawns and resting adults. Dholes adopted the former strategy 39 times and the latter 14 times in total.

Rush and chase

Other than gaur, wild pig and occasional sambar all prey ran when chased by dholes. Handicapped prey trailed behind (e.g., hunt 6). Dholes may determine vulnerability by the prey's initial reaction. During the early phase of the chase dholes run faster than the prey. Owing to this and team work most of the chases did not last long. In 92% of 48 occasions the chase ended within 500 m of its starting point. Twice the chase went beyond 500 m (e.g., hunt 1) and on two occasions the distance could not be assessed.

One widely prevalent belief is dholes hunt in relays pursuing prey casually at a loping canter until the quarry is exhausted (Burton 1940, Davidar 1975, Krishnan 1975b). In a dense habitat especially where many animal tracks crisscross it would be difficult for dholes to run in relays or follow a prospective prey animal for a long distance. Even in the African plains *Lycaon* hunt occasionally in brief relays (Kruuk and Turner 1967, Schaller 1972) but Estes and Goddard (1967) never saw a true relay chase.

Attack and kill

Small mammals like hare and chital fawn were seized by any part of the body as they ran. With a single head shake such small prey were killed instantly (e.g., hunts 8 and 14). Dholes were capable of inflicting serious wounds on the rump and flanks of the larger prey (hunts 5 and 6) and consequently even large chital stags were brought down (e.g., hunt 10).

Generally larger animals are attacked from behind and the usual points of attack are rump and flank. Dholes are wary if prey are capable of injuring either with antlers or forelegs (hunt 9). The nose hold seen in wolves (Mech 1970) and *Lycaon* (Estes and Goddard 1967, Van Lawick 1971, Schaller 1972, Malcolm and Van Lawick 1975) was used by dholes when the speed of the prey was arrested. Nose holding enabled dholes to accelerate their attack on the rump and flank which ultimately subdued the victim. If the prey's nose is caught while it stands in water the weight of the dhole may drown the prey before the dhole frees itself from suffocation. This was interpreted as intentional drowning of the prey by dholes (Sankhala 1977). However, I cannot believe that dholes drown their prey intentionally. Once the nose hold was used to drag a chital fawn out of water (hunt 13).

During this study 27 out of 40 fresh kills had snout injury (4 sambar ♂♂, 6 chital stags in velvet, 15 chital stags in hard antlers, 1 chital doe and 1 sambar fawn). Snout injury occurred in all sambar males, in 55% of chital stags in velvet and in 82% of chital stags in hard antler. More chital stags in hard antler were injured on the snout by nose hold than expected (Hypergeometric distribution, p. 0878, $p > .05$).

Attack on the rump and flanks led to evisceration. Bite wounds, shock and loss of blood eventually killed the prey. Of 40 fresh kills checked none had throat wounds. Dholes removed the scrotum during hindquarter attack and this has led to the popular belief that they deliberately emasculate their prey. The scrotum was usually eaten as it was found on only 4 occasions ($n = 33$).

Prejudice against dholes arises from their method of disemboweling prey and eating them alive (hunts 3 and 9). Ten direct observations showed that prey weighing 50 Kg or less were killed within 2 minutes after the attack began. The maximum time was 15 minutes (hunt 9). Killing was delayed by human interference as 'some members of the pack hung back apprehensively and were not able to do their share in killing' (Van Lawick 1971). In the absence of human interference a yearling ♂ sambar was killed within 7 minutes by the pack of 15 (hunt 3).

Dholes do not deserve the reputation as cruel hunters as their method and time required to kill are not much different from those of other predators. Hyenas take 1 to 13 min. (Av. = 6.3) to kill wild beast (Kruuk 1972). A lioness took more than 8 min. to kill a warthog and 3 lionesses more than 7 min. to kill a zebra (Schaller 1972). Tigers (Burton 1925) and lions (Schaller 1972) have been reported to eat their prey alive. Obviously natural selection has led to effective means of disabling prey (incapacitation) rather than quick and painless death.

When the pack moves through the scrub there may be opportunities to attack 2 or 3 large prey animals. There was only one incident of dholes, however, killing 2 large chital stags at one time. This suggests dholes are not wanton killers. Kills were not made by a particular dhole (see hunts 1, 6, 10, 11 and 13).

Sequence of eating a carcass

Dholes fed excitedly soon after killing. The belief that every dhole gets its share was not true when kills were small (e.g., hunt 1). Even for medium sized animals like chital doe and sambar fawn, especially when the undivided pack was around, there was always squabbling until the excitement of the hunt was over. Fawns were torn to pieces within seconds after killing and each dhole ran away with its share (e.g., hunt 8). Even when the kill was as large as a yearling sambar or an adult chital stag all pack members did not lie around the kill and eat. When my presence was noted they dragged the kill away (e.g., hunts 2, 5, 12 and 17) and once a male weighing nearly 18 kg dragged a 49 kg chital doe for 5 m through grass and creepers.

As all dholes could not eat at the rump they tugged at the carcass from all directions. Belly and loin were soon torn open and the entrails were pulled out. The viscera were dragged aside (hunts 3, 9, 13 and 24). If it was a fawn the intestine was eaten spilling the contents. The rumen was usually left though its tissue was some times eaten. Lungs were often torn out but were not always eaten. There was always a scramble for the liver and the heart.

Dholes seemed to relish the eye balls. Of the 40 fresh kills checked 21 had both eyes removed, in 8 cases left and in 6 cases right eye were removed. Five animals had intact eyes. In 4 hunts dholes removed the eye balls as soon as the kill was made. Pinnae were also eaten. Of the 40 kills both the pinnae were removed in 17 animals, left pinnae in 12 and right in 5. In 16 cases pinnae were present. Uneaten dismembered pinna was (three times) found close to kills.

When a kill was fully eaten dismembered parts of the prey were left around the kill site. Usually the vertebral column with the attached ribs and the skull formed the main piece. The limb bones and pectoral girdle were usually separated. If the prey was large the skin was neatly removed of meat and then left with the head attached. When dholes ate a mature chital stag (around 75 kg) the remains weighed around 25 kg. (33%). However, on 4 occasions the remains varied between 51 and 68% (Av. = 55). Dholes left these kills in the absence of human disturbance. This contradicts the belief that dholes leave only bone fragments even from large kills such as adult sambar.

Feeding dholes frequently drank if water was nearby. If water was some distance away they headed for the nearest waterhole soon after eating. When the day became hot before the kill was eaten dholes did not go to their distant rest sites. Instead they found shelter under dense thickets near the kill till the evening.

Speed of eating and meat consumption rate

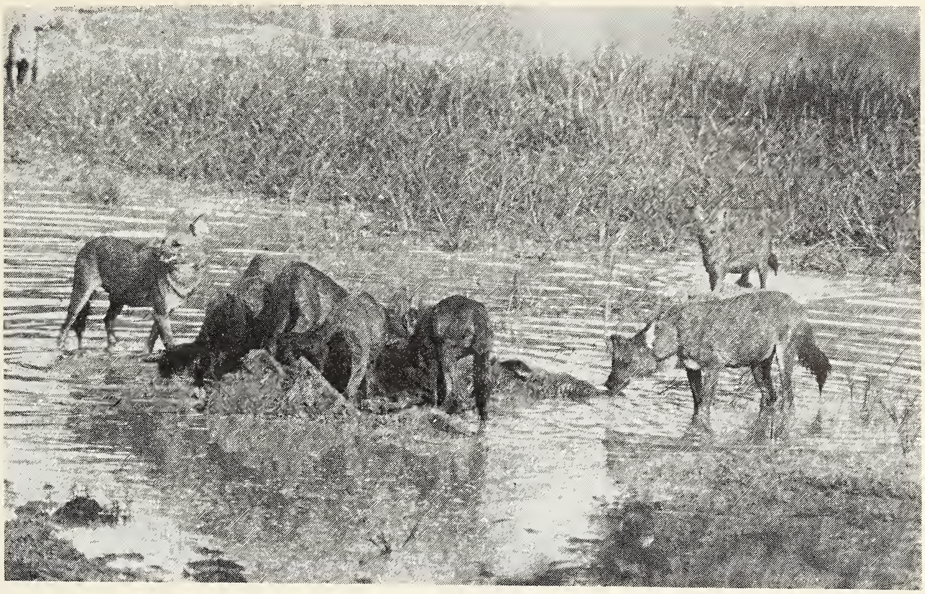
As Kruuk (1972) noted in hyena competition between feeding dholes expressed itself mostly in the speed of eating rather than in fighting. Dholes consumed their kills quickly. The pack (9 adults + 9 pups) once ate 50 kg of meat from a 70 to 75 kg chital stag within 90 min. They were aware of my presence and had a brief uninvited interaction with 4 village dogs. Another time 8 adults and 7 pups ate 14 kg of meat from a yearling chital doe (30 to 35 kg) within 4 min.

For three periods I collected almost all the kills made by the pack (Table 11). The prey varied from chital fawn to chital stag, number of dholes ranged from 15 to 18 and the meat available per dhole varied between 0. 7 kg and 3 kg. The total meat consumed by a dhole during the 15 day period was 27.9 kg (1.86 kg of meat per day or 0.103 kg of meat per kg of 18 kg dhole). This is comparable to the consumption rates for wolves (2.6 to 6.3 kg per wolf per day or 0.09 to 0.19 kg per kg., Mech 1966) and for *Lycaon* (2.0 to 4.0 kg per *Lycaon* per day or 0.11 to 0.15 kg per kg, Estes and Goddard 1967). The estimate for the dhole may be a little lower than the actual amount of meat eaten as they may be feeding on smaller animals which would go unrecorded. My observations indicate that when dholes ate about 2 kg in the morning they did not hunt in the evening. On 7 occasions when the morning kill provided each dhole < 2 kg of meat they hunted again in the evening. On 6 occasions when the first kill was a fawn one more kill was made in the same hunting session.

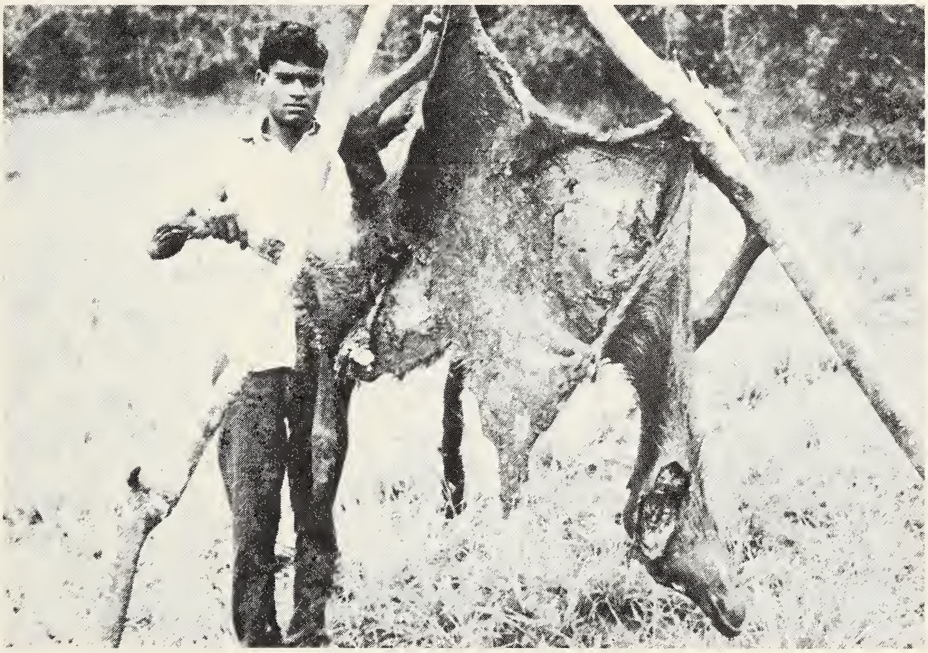
Scavenging and attendant scavengers

Dholes scavenged once on a tiger kill (Johnsingh 1979b) and 7 times on leopard kills. Dholes returned and ate their own kills for the second time either on the same day or 2 or 3 days after (n = 11). Although dholes were not seen hunting langurs remains of langurs were seen in 6 dhole scats. This may have been the result of scavenging. Food caching was not observed though it is seen in wolves (Murie 1944) and rarely in *Lycaon* (Malcolm 1980).

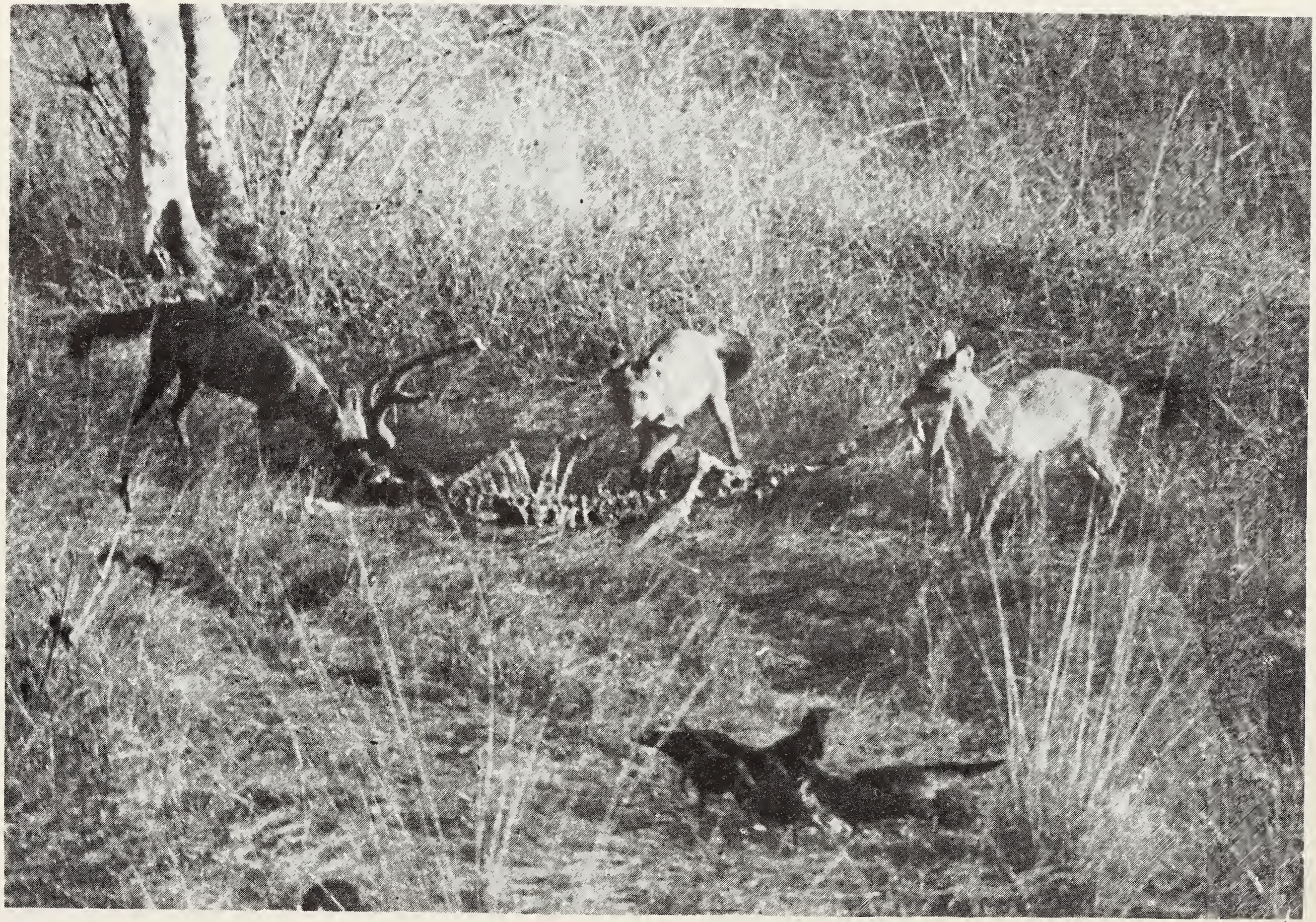
The jungle crow was the major scavenger at Bandipur. Besides this there were King Vultures (*Torgos calvus*), Whitebacked (*Gyps bengalensis*), Longbilled (*Gyps indicus*), Pariah



Dholes at a sambar kill.



Sambar skin removed of meat by Dholes.
(Photos: *Author*)



Dholes at a chital stag kill. Jungle Crows are in the foreground.
(Photo: *Author*)

TABLE 11

ESTIMATION OF MEAT CONSUMPTION RATE OF DHOLE

S.No.	Date and time	Particulars of prey	Estimated weight (in Kg.)	Weight of remains (in Kg.)	No. of dholes	Average meat available per dhole (in Kg.)
1.	7 Sept. '77 morning	Chital stag velvet age class V	70–75	30	16 or 17	2.5
2.	8 Sept. '77 evening	Chital doe age class VIII	50	10	„	2.5
3.	9 Sept. '77 < 0600	Chital doe age class VI	50	9	„	2.5
4.	10 Sept. '77 1800	Chital stag hard 88 cm, age class V	75	30	„	3
5.	11 Sept. '77 0730	Big chital fawn	30	6	„	1.5
6.	11 April '78 0830	Chital fawn	20	2	18	1
7.	12 April '78 0600	Chital fawn	15	1.5	18	0.7
8.	13 April '78 0610	Chital stag velvet, age class VI	75	21	18	3
9.	14 April '78 < 0600	Chital doe, age class VIII	50	12	18	2
10.	15 April '78 1830	Chital stag velvet, age class VI	70–75	24	18	2.5
11.	16 April '78 1900	Sambar fawn	30	3	18	1.5
12.	15 June '78 0800	Chital yearling doe age class II	30	5	15 or 16	1.7
13.	16 June '78 0630	Chital fawn	15	1.5	„	0.8
14.	17 June '78 1100	Chital fawn	25	3	8 adults 7 pups	1.5
15.	18 June '78 1400	Chital fawn	20	2	„	1.2

Kites (*Milvus migrans*) and on one occasion a White Scavenger Vulture (*Neophron percnopterus*). Village dogs scavenged on dhole kill remains four times.

OBSERVATIONS ON OTHER PREDATORS

Tiger

There were 18 sightings. The tigress of the area was followed by 2 cubs from the end of May 1977. Sightings of the 3 till March 1978 indicated that the tigress was successful in rearing the cubs.

Once when I mimicked the whistle of a dhole, suspecting the presence of a predator in the scrub, a tiger came out growling and stood at the edge of the scrub with pinnae laid flat. I

TABLE 12

FREQUENCY OF OCCURRENCE OF FOOD ITEMS IN 67 JUNGLE CAT SCATS COLLECTED IN BANDIPUR

Food item	Frequency of occurrence No. of scats	Per cent
Rat and mouse	43	64.17
Bird remains	9	13.43
Hare	7	10.45
Lizard	5	7.46
Chital fawn	3	4.48

3 scats had grass — 2 in combination with rat remains and 1 with bird remains.

9 scats had insect remains — 7 along with rat remains, 1 with bird remains and 1 with hare remains.

mimicked dhole whistle another time when a tiger left a waterhole. The tiger turned back came forward two steps and then sat and looked for 2 minutes in my direction.

Sloth bear

There were 16 sightings but tracks and droppings showed that sloth bear were not rare. During April 1977 when water was restricted to the perennial ponds tracks showed that 3 adults and 1 young made use of the core area.

Of the 95 scats analysed over the period August 1976 to July 1977 one had bones and hairs of hare and another a beetle wing. Forty nine had earth, termites and ants probably of the genus (*Componotus* spp.); 35 had earth and fruit, 4 earth and grass and 5 earth and beeswax. *Cassia fistula* seeds were seen in December, March, April and May; *Zizyphus jujuba* fruits in January; *Cordia myxa* and *Syzygium cumini* in June and July. These findings are similar to those of Laurie and Seidensticker (1977).

Jungle cat

There were 28 sightings; 14 were in September and October. Results of the scat analysis are presented in Table 12. One dead jungle cat was seen and cause of death could not be ascertained as crows had mutilated the carcass.

Jackal and others

There were 13 sightings of jackals 5 of which were of pairs. Eleven sightings were in dry months.

Stripe-necked mongoose were seen 8 times hunting for small animals along pond margins.

Python was seen 5 times and once a python killed a chital fawn.

Crested Hawk Eagle was the most common avian predator of hare and peafowl.

KILLS LOCATED

In the core area 233 chital, 56 sambar, 1 wild pig, 3 hare and 2 cattle calves, all killed

TABLE 13

COLLECTED KILLS OF DHOLES, LEOPARD AND TIGER IN BANDIPUR (AUGUST 1976 — JULY 1978)

	Chital*			Sambar			Wild	Hare	Langur	Cattle	Ele-	Village	Dhole	Leo-
	Fawn	♀	♂	Fawn	♀	♂	Pig				phant	Dog		pard
Dhole	100	68	64	46	3	7	1	3	—	3	—	—	—	—
Leopard	11	18	9	2	—	1	—	—	1	10	—	5	1	—
Tiger	1	3	1	1	5	1	4	—	—	1	1	—	—	1

* Seven chital kills by dholes could not be aged and sexed.

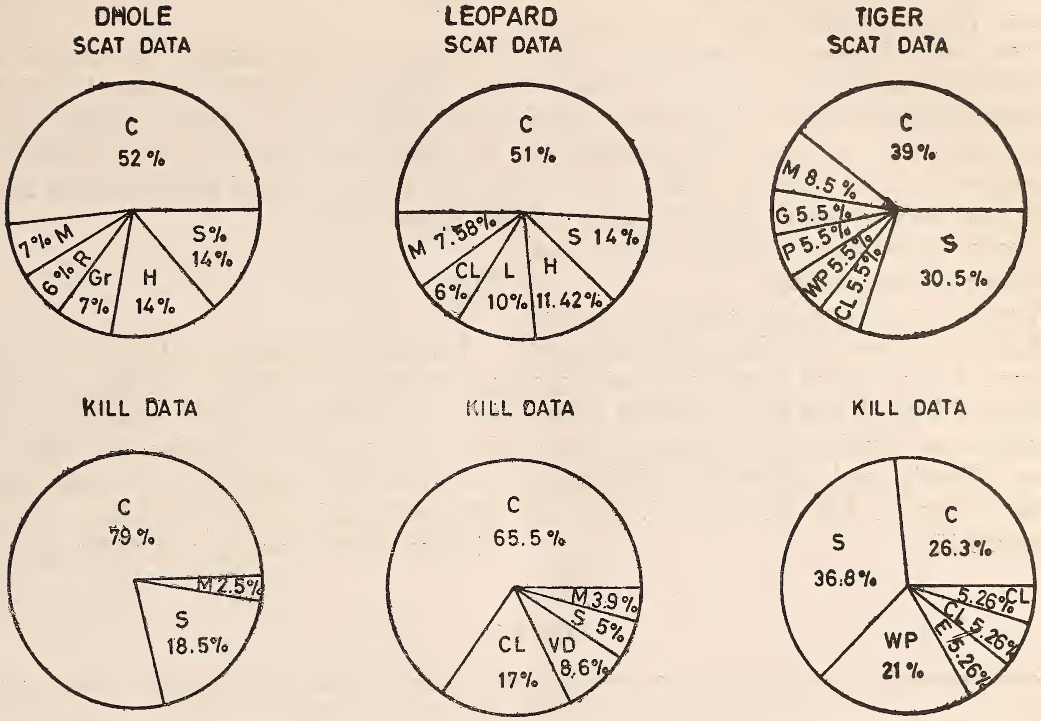


FIG. 12. FOOD ITEMS OF DHOLE, LEOPARD AND TIGER AS SHOWN BY SCAT AND KILL DATA. C: CHITAL, S: SAMBAR, H: HARE, WP: WILD PIG, R: RODENTS, CL: CATTLE, P: PORCUPINE G: GAUR, Gr: GRASS, VD: VILLAGE DOG, LC: LEOPAPD CUB, E: ELEPHANT CALF, M: MISCELLANEOUS.

by dholes, were collected. Outside the core area 6 chital and 1 cattle calf kills of dholes were seen. In total 302 dhole kills were seen (Table 13 and Fig. 12).

Of the 58 kills by leopard (Table 13 and Fig. 12) 66% was chital and 5% sambar. Inability to collect sambar fawns killed by leopard may be due to their occurrence in the scrub. Ten cattle and 5 village dogs were also killed by leopard.

A classification of tiger kills (n = 19) is shown in Table 13 and Fig. 11. Chital and sambar fawn kills of tiger are well represented in scats (Fig. 12) but 1 chital and 1 sambar fawn killed by tiger were collected. This is mostly due to tiger's ability to consume more than 20 kg of meat in one night and to dispose of small kills within hours.

SCAT DATA

Dhole

Of the 509 scats 24 had remains of more than one animal species. Chital was the most common prey eaten (Table 7, Fig. 12) followed by hare and sambar. Although only 3 cattle calves were killed by dholes 14 dhole scats had cattle remains. Nearly 500 cattle were driven through the Reserve to the slaughter houses in Kerala. Weak and unfit cattle abandoned on the road were frequently killed by the local people and leopard. Scavenging on the remains of these cattle may account for 14 dhole scats having had cattle remains. In the months of September and October, after the onset of north east monsoon, partly chewed remains of the beetle (*Dorysthenes rostratus*) were found with other animal remains.

Thirty five scats consisted almost entirely of fresh grass. On two occasions grass was seen wrapped around chital fawn hoof and bone splinters of hare. A scat had 5 *Lantana* leaves, *Themeda* and *Cymbopogon* spp grass, 3 tape worms (*Taenia* spp.) and mucous. Estimation of the number of kills from scats is given in Appendix II.

Leopard

Results of the analysis of leopard scats (n = 70) are presented in Figure 12. Of these chital formed 51%, sambar 14% and the rest was composed of cattle, langur and hare. Calculation of the number of kills from scats is given in Appendix II.

Tiger

Results of the analysis of tiger scats (n = 36) are presented in Figure 12. Three scats contained soil along with the remains of chital fawn (1 scat) and porcupine (2 scats). Two scats (one with sambar fawn remains and the other with cattle remains) had large quantities of grass. Thirty nine per cent of the scats con-

TABLE 14

A CORRELATION OF SCAT AND KILL DATA TO ESTIMATE THE EXPECTED KILLS AND BIOMASS OF WILD PREY REMOVED FROM THE FOCAL AREA BY THE DHOLES

Prey species and their weight (in Kg.) used in computation		No. of meals the pack (13 animals) can have	No. of scat samples with the remains of	Corrected estimate of scat	Observed Kills	Expected Kills	Corrected estimate of Kills	Biomass of corrected estimate of kills (in Kg.)
*Adult and yearling sambar	(110)	2	18	21	10	9.5–12	11	1210
Sambar fawn	(32)	1	54	63	46	54	63	2016
**Chital adult				148	134	131	153	9098
	(♂ : 69; ♀ : 44)	1	127					
Chital fawn	(15)	0.5	143	167	98	286	334	5010
Muntjac	(15)	0.5	8	9	—	16	18	270
Wild pig	(30)	1	5	6	1	5	6	180
Hare	(2)	0.08	74	86	3	222	258	516
Gaur calf	(50)	1	1	1	..	1	1	50
Rodent	(0.1)	0.004	34	40	..	8160	9600	960
							Total ..	19310

*Average weight, derived from actual weights, is used in computation.

**Biomass of corrected estimate of kills was calculated based on the sex ratio seen in the kill (94♂ : 100♀).

TABLE 15

CORRELATION OF SCAT AND KILL DATA OF THE LEOPARD

Prey species and their weight used in computation (in Kg.)	No. of meals a leopard can have	No. of scat samples with the remains of	Probable occurrence of scats with 95% confidence interval		Corrected estimate of scats *		Observed Kill	Expected Kill	Biomass (in Kg.)
			Lower Limit	Upper Limit	Lower Limit	Upper Limit			
Yearling sambar (130)	4	2	1%	8%	5		1	1	130
Sambar fawn (32)	2	8			6	40	2	3–20	640
*Chital adult ♂ : 69, ♀ : 44	3	10			9	50	27	3–17	1413
Chital fawn (15)	1.5	27			24	135	11	16–90	1350
Muntjac (15)	1.5	2			2	10	—	1–5	75
Hare (2)	0.33	8			6	40	—	18–120	240
Langur (8)	1	7			6	35	1	6–35	280
Porcupine (8)	1	1			1	5	—	1–5	40
Rat (0.1)	0.01	1			1	5	—	100–500	50
Total ..		66**							4218***

* Biomass is calculated for the kill observed. (9♂ : 18♀)

** Excluding 4 scats with cattle remains.

*** Biomass of 10 cattle and 5 village dog kills is not included.

tained chital, 31% sambar and the rest was composed of cattle, pig and gaur remains.

DISCUSSION

In this report I have presented observations on the large mammalian prey predators in the core area of my study in Bandipur. While dholes were primarily diurnal, tiger and leopard were essentially nocturnal. All the three predators chiefly preyed on chital and sambar and the local people derived their animal protein stealing chital and sambar kills. The basic questions that are to be answered to fully understand the interactions among the prey, predators and local people are as follows :

a) What was the prey-predator ratio?

b) What ecological and behavioural features isolated the predators in the core area?

c) What ecological conditions permitted the co-existence of predators?

d) What was the effect of predation on chital and sambar population? and

e) What was the impact of people stealing chital and sambar killed by predators?

The answers to the last two questions are presented in Appendix III and IV.

PREY-PREDATOR RATIO

From the scat data it was inferred that dholes killed 19,310 kg (Table 14), leopard 4,218 kg

(Table 15) and tiger 3203 kg including the elephant calf (Table 16) of prey biomass in the core area. This was nearly 20% of the 66,400 kg (average biomass was 3,320 kg/Km^2 and the core area was 20 Km^2), the average total biomass calculated for the core area. This serious predation is probably because of the sudden removal of 100 + cattle from the study area at the onset of the study. Inspite of this heavy predation there was a significant increase in chital and sambar population (Appendix III and IV).

Average predator biomass 534 kg (13 dholes = 234 kg; tiger = 180 kg, 2 leopards = 120 kg) and prey biomass showed a ratio of 1:124. In Ngorongoro Crater the ratio was 1:100 and in Serengeti 1:250-300 (Schaller 1972).

ECOLOGICAL SEPARATION OF PREDATORS

When several predatory species hunt in the same area competition in the sense of joint demand for a limited prey resource is likely to occur. One way in which such competition can be reduced is for the predators to occupy different habitats or to use the same one at different times (Schaller 1972). Table 17 lists 15

TABLE 16

CORRELATION OF SCAT AND KILL DATA OF TIGER

Prey species and their weight used in computation (in Kg.)	No. of meals a tiger can have	No. of scat samples with the remains of	Probable occurrence of scats with 95% confidence interval		Corrected estimate of scats		Observed Kill	Expected Kill	Biomass of expected kill (in Kg.)
			Lower Limit	Upper Limit	22		6	6	1200
Sambar adult (200)	4	2	1%	22%	Lower Limit	Upper Limit			
					3	63			
Sambar fawn (32)	1.5	9			27	567	1	18–378	576
*Chital adult ♂ : 69; ♀ : 44	2	6			18	378	4	9–189	446
Chital fawn (15)	1	8			24	504	1	24–504	360
Muntjac (15)	1	1			3	63	—	3–63	45
**Wild Boar (50)	2	2			6	126	4	3–63	200
Gaur Calf (50)	2	2			6	126	—	6–63	150
Hare (2)	0.15	1			3	63	—	1–9	2
Porcupine (8)	0.5	2			6	126	—	3–63	24
Total . . .		33***							3003****

* Sex ratio in the kill was 1♂ : 3♀.

** Biomass is calculated for the observed kills.

*** One more scat with grass and earth was collected.

**** If the elephant calf weight is added the biomass reaches 3203 Kg.

mechanisms that reduce competition between Bandipur predators.

Differential use of habitat

Signs of predators were seen in 138 quadrats of the core area (n = 219). Hard terrain and tall grass were the major reasons for not recording predator occurrence in other quadrats. Of the 138, indications of all the 3 predators were seen in 31 (23%). Evidence for dhole alone were seen in 35 (25%) and such figures for leopard and tiger were 13 and 7 respectively. Thirty seven quadrats (27%) contained sign of dhole and leopard. Dhole and tiger signs and clue to tiger and leopard occurrence were seen in 9 and 6 quadrats respectively. This suggests possible 'tolerance' (mutual use of space) between dhole and leopard and 'intolerance' between leopard and tiger. This 'intolerance' led to a tiger killing and eating a leopard cub (Johnsingh 1979a) and 'tolerance' resulted in a leopard killing a dhole pup. Schaller (1967) and Seidensticker (1976a) report avoidance between tiger and leopard.

Large cats like the tiger (Schaller 1967, Sunquist 1981) and the lion (Wright 1960) rarely kill prey on short grass or open habitats. In areas north east of Bandipur, where vegetation was thin, 56 quadrats were checked for predator signs. Dhole, leopard and tiger signs were found in 21, 13 and 2 quadrats respectively. Fifty six quadrats in dense vegetation, south west of Bandipur, yielded 47, 39 and 28 quadrats with signs of dhole, leopard and tiger respectively. This indicates preference of tiger for dense vegetation.

TABLE 17

ECOLOGICAL DIFFERENCES AND BEHAVIOURAL SEPARATION BETWEEN PREDATORS

Ecological and behavioural parameters	Tiger	Leopard	Dhole
Nocturnal ..	+	+	—
Diurnal ..	—	—	+
Need for cover ..	+	+	—
Tolerance for sun ..	—	+	—
Need for water ..	+	—	+
Tolerance for human disturbance ..	0	—	—
Arboreal ..	—	+	0
Smallest mammal killed (scat analysis) ..	Hare	Rat	Rat
Largest wild mammal killed ..	Elephant calf	Sambar yearling stag	Adult sambar doe
Food caching ..	+	+	0
Scavenging ..	+	+	+
Tolerance for rain ..	+	—	+
Sociability ..	Solitary	Solitary	Social, lives in packs
Territory marking ..	+	+	+
Intraspecific/Interpack tolerance ..	—	—	?

+ Yes, Great; – Less; 0 Absent.

All 19 kills by the tiger and 55 of the leopard ($n = 58$) were found in scrub. Sixty three per cent of fresh kills of dholes ($n = 219$) were in scrub, 17% in meadows, 9% on or near roads, 8% in or near water and the rest in tree jungle and near stream beds. Dholes like leopards and tigers, entirely do not require cover for killing prey.

Prey size

All three predators were capable of killing large prey but in tiger kills the $>$ 100 kg class formed 42% (Table 18). Larger species must rely upon energy source that occur in large food items unless they can collect smaller prey with great efficiency (McNab 1963) and carnivores usually prey upon herbivores of about their own size and weight (Bourliere 1963). Excluding 8 adult cattle kills 69% of leopard kills weighed $<$ 50 kg. Kruuk and Turner (1967), Pienaar (1969) and Schaller (1972) have recorded that leopards very rarely kill prey heavier than 100 kg. Of the dhole kills the $>$ 100 kg class formed 1%, 50 to 100 kg group 25%, 25 to 50 kg group 32% and $<$ 25 kg class 42%.

TABLE 18

WEIGHT CLASSES OF KILLS OF THE TIGER, LEOPARD AND THE DHOLE

Weight class in Kg.	$<$25	25-50	50-100	$>$100
Tiger — kills	2	8	1	8
Percent in total kills	10.5	42.1	5.26	42.1
Leopard — kills	18	22	9	9 (1 Sambar + 8 cattle)
Percent in total kills	31	37.9	15.5	15.5
Dhole — kills	127	96	75	4
Percent in total kills	42	31.78	24.8	1.3

No evidence of leopard killing wild pig was seen in Bandipur which was frequently observed in Wilpattu (Eisenberg and Lockhart 1972) and in Chitawan (Seidensticker 1976a). Dholes also very rarely killed wild pig. On the contrary tiger killed 4 adult boars which formed 21% of their total kills. When chital, an easier prey to kill, are abundant leopard and dhole may not risk attacking either a solitary boar which may be difficult to kill or a member of the sounder which can trigger off the protective instinct of the sounder. The ability of the tiger to hunt prey ranging from hare to elephant calf indicates that tigers use a much wider spectrum of food resources.

Prey density and utilization by predators

In July 1977 the total number of prey animals in the core area (excluding porcupine, hare and peafowl) was 1247 to 1310. Of this chital constituted 69%. Kill data show that chital formed 79, 66 and 26% respectively of the prey of dholes leopard and tiger. Fifty two per cent of dhole, 51% of leopard and 39% of tiger scats had chital remains (Fig. 12). Fewer chital remains in the scats of dholes is due to the occurrence of the remnants of hare and rodents in scats which are not included in the total number of prey (1247-1310). It is also due to the scavenging by the dholes on cattle and langur which are poorly represented in kill data. The same situation lowers the occurrence of chital remains in the scats of leopard.

Tiger scat and kill data reveal that proportionately fewer chital were killed than were present in the population. This can be attributed to the antipredator behaviour of chital which assemble in the campus and in open areas to spend the night where they are immune to tiger predation. More over, preference of chital for areas around Bandipur, where tiger may not be able to hunt in day time, keeps a major fraction of the population free from tiger predation.

Sambar were only one fifth as abundant as chital. Yet tiger proportionately preyed more on sambar (Fig. 12). Sambar use the scrub intensively, live in small groups and do not rest in open areas. These ecological and behavioural factors make the less abundant sambar more vulnerable to tiger predation or tiger may specifically hunt sambar.

Predation and sex of prey

Males are said to be more susceptible to predation. Weakened condition after rut (Hornocker 1970) and territorial contest (Estes and Goddard 1967, Schaller 1972) make ♂♂ vulnerable to predation. During this study 132 yearling and adult chital killed by dholes were collected. The ratio in the kill was 94 ♂♂ : 100 ♀♀ and in the population it was 84 ♂♂ : 100 ♀♀. Predation of ♂♂ was not significantly different from expected.

Dholes very often killed stags with long antlers (Figs. 13 and 14, Table 19). Two hypotheses could be offered for stags with long antlers being vulnerable to predation:

a) Stags with long hard antlers which take an active part in rut (Sharatchandra and

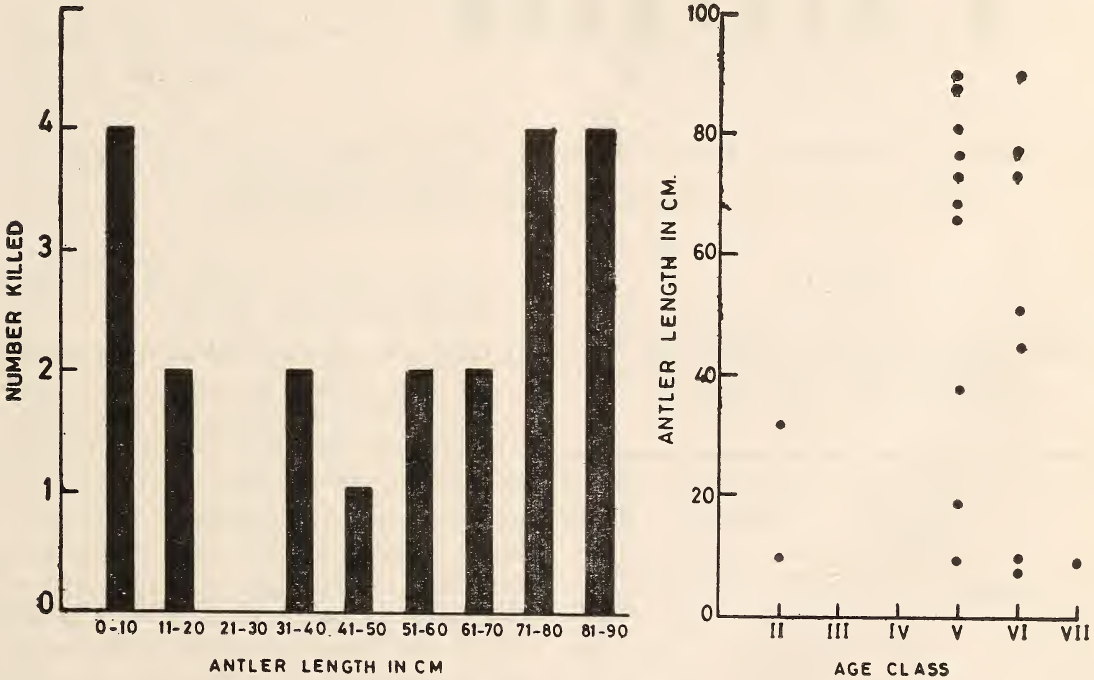


Fig. 13. Antler length and age classes of 20 chital stags in velvet killed by dholes; 3 animals in shed antlers are included in 0-10 category (August 1976 to July 1978).

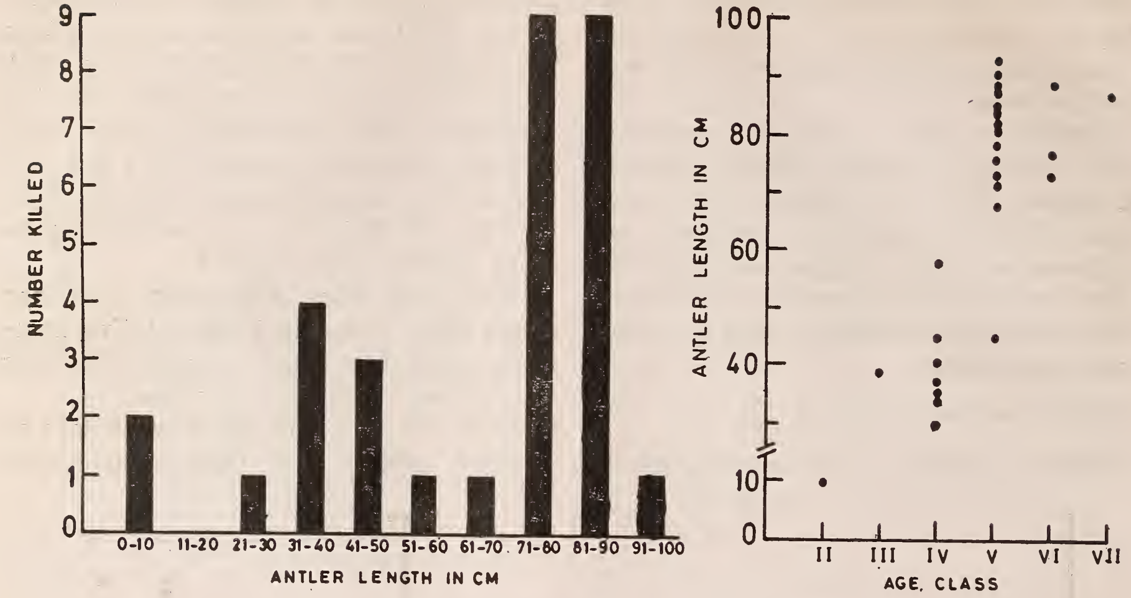


Fig. 14. Antler length and age classes of 31 chital stags in hard antlers killed by dholes (August 1976 to July 1978).

TABLE 19

HARD ANTLER LENGTHS OF CHITAL ♂ ♂ FROM THE POPULATION AND FROM DHOLE KILLS AUGUST 1976-JULY 1978 — BANDIPUR

	Stags with < 25 cm. antlers	25–50 cm antlers	> 50 cm antlers
Random sample from the population (n = 77)	26	27	24
Kills (n = 31)	1	8	22

Preference to kill stags with longer antlers was significantly greater than expected.
$X^2 = 15.6$, d.f., 1, $P < .001$.

Gadgil 1980) are indifferent to predators and are spent after the rut;

b) there is strong sexual selection among males for large antlers but there is also counter selection by predators against large antlers.

Number of chital stags in hard antlers killed by dholes in different months (Table 20) did not indicate any significant concentration during or after rut. Nor any significance was seen when the kill data were compared with chital stags in hard antlers in the population (Table 21). Hence the first hypothesis is rejected. The explanation for the second hypothesis is that stags with large antlers may be hampered when running through dense vegetation and are easily killed.

During fawning does frequently visit scrub which may make them more vulnerable to tiger

TABLE 20

NUMBER OF CHITAL STAGS KILLED BY DHOLES IN DIFFERENT MONTHS (AUGUST 1976 TO JULY 1978)

	J	F	M	A	M	J	J	A	S	O	N	D	Total
Stags in hard antlers	—	—	4	3	4	3	6	3	3	4	4	—	34
Stags in velvet antlers	3	3	4	8	3	—	1	2	2	1	1	2	30

TABLE 21

CHITAL STAGS IN HARD ANTLERS KILLED BY DHOLES AUGUST 1976-JULY 1978, BANDIPUR

	Stags counted	Kills	Kills collected for equal # of stags
May to October	1897	23	8.24
November to April	680	11	11

Preference to kill stags from May to October (rutting season) was not significantly greater than expected.
$X^2 = 0.4$, d.f., 1, $P > .05$.

TABLE 22

RELATING CHITAL KILLS WITH PROBABLE NUMBER OF SCATS PRODUCED

	Chital fully eaten	Chital eaten more than once	Chital stolen after some feeding	Chital stolen before any feeding	Kills of leopard scavenged	Total
Kills	113	7	6	8	4	138
Probable number of scats produced	113	14	3	0	4	134

and leopard predation. Tiger Kills (1♂ + 4♀♀) and leopard kills (9♂♂ + 18♀♀) had more does than stags; however, even leopard predation of does was not significantly more common than expected ($X^2 = .463$, d.f., 1, $P > .5$).

Sex ratio in the sambar population was 41 ♂♂ : 100♀♀ and in dhole kills the ratio was 233♂♂ : 100♀♀ (n = 10). Dholes killed more males than expected ($X^2 = 11.95$, d.f., 1, $P < .005$). All males killed were yearlings or young adults which suggests that their solitary habits may have made them prone to dhole predation.

Predation and age of prey

Chital of the age class II, III and IV because of their agility and alertness may escape dholes but often fall prey to leopards which hunt by stealth and surprise. Chital belonging to the above mentioned classes formed 25% and 37% of the total yearling and adults killed by the dholes (n = 131) and leopard (n = 27) respectively. Forty three per cent of chital killed by dholes (n = 231) were fawns and the corresponding figure for leopard was 23% (n = 38). The inability of dholes to kill more yearling and young adult chital is similar to coyote predation where deer between 2 and 6 yrs. of age appear most secure from coyote caused mortality (Ogle 1971). Similarly wolf predation is heaviest on fawns and old animals (Murie 1944, Mech 1966, Pimlott *et al.* 1969, Kolenosky 1972).

Yearling females of age class II and III were much more susceptible to dhole predation (19% of ♀ kills, n = 67) than yearling males (6% of ♂ kills, n = 64). The probable reason was pregnancy.

Caching food

Dholes did not cache food and this may result from the absence of any significant remains from a meal. Tiger and leopard usually cached the kill when it was large enough to afford more than one meal. Curiously leopards in Bandipur had left 6 chital kills, all $<$ 50 kg, in open and a hind leg of only one chital was covered with litter and earth. The leopard carries its kill up a tree when potential food thieves are about (Ewer 1973). In Chitawan leopards pulled about half of their kills up trees (Seidensticker 1976a) and in Wilpattu kills were kept in trees to keep them safe from hunting packs of jackals (Eisenberg and Lockhart 1972). In Bandipur in spite of the frequent scavenging by dholes and human beings leopards hauled their kills up trees only three times.

ECOLOGICAL CONDITIONS PERMITTING THE CO-EXISTENCE OF PREDATORS

Large prey biomass, a large proportion of ungulate biomass in the smaller size classes and dense vegetation structure enabled tigers and leopard coexist in Chitawan (Seidensticker 1976a). The prey biomass of the core area (3320 kg/Km^2) is higher than the 2400-2500 kg/Km^2 of wild and domestic prey biomass of Kanha (Schaller 1967) and 766 kg/Km^2 of Wilpattu (Eisenberg and Lockhart 1972) and the 2789 kg/Km^2 of Chitawan (Seidensticker 1976b). As in Chitawan in the core area there were not many species of ungulates in the small size classes and chital alone formed 69% of prey number or 48% of large hoofed mammal biomass. The heterogeneous habitat of the core area with many stream beds may be much more ideal for the predators and the prey species than the tall grass/riverine forest of Chitawan and the open short grass meadow/*Shorea* forest habitat of Kanha.

Complexity of vegetation types, high prey biomass and a large number of chital as the optimum prey for dhole and leopard and a sizable population of sambar and wild pig for the tiger allowed these predators to coexist in the core area. An analysis of the factors mentioned in Table 17 shows that the first 12 parameters could determine the survival of the three predators. A predator which can survive in a deteriorating habitat should be both nocturnal and diurnal and should have the ability to feed on small and large prey. Further the capacity to cache food, climb trees and scavenge would also promote survival. Hence leopards would survive in a much disturbed habitat where dholes would be rare and tigers totally absent.

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APPENDIX I

DETAILS OF 25 DHOLE HUNTS

Sl. No.	Date	Time of observation	Weather + Place	in the Pack	Prey	Antipredator Strategy	Hunting Strategy	Duration and distance of the chase	Time of kill and time taken to kill	Mode of killing	Duration of feeding	Kill remains	Scavengers	Other observations
1.	13 Aug. '76	1600-1855	Cloudy, Thavarakatte	10+	Chital fawn	Tried to run into a pond	Flushing prey to waiting dholes	< 2 min.; > 500 m	1846; within seconds	Not observed	8+min	Rumen content, limb bones, scapula and part of pelvic girdle	10 crows next morning	One dhole (not 'Bent Ear') killed and ate most of the fawn. Two dholes drank and lay in water.
2.	16 Aug. '76	1500-1730	Cloudy, shooting hide	15	Chital fawn	Flight	-do-	< 2 min ; c 300 m	1634; within seconds	Evisceration	20+min	Kill was dragged into bush	6 to 8 crows arrived 30 min after kill was made	—
3.	24 Aug. '76	1430-1750	Cloudy, Kerigowdanakatte	15	Yearling ♂ sambar	Tried to run into a pond	-do-	Not recorded	1653; 7 min	Evisceration, ate the deer alive	60+min	Weighed 30 kg. Viscera was dragged aside. Eyes were removed	Nil	A sambar doe and a fawn, feeding 100m away, sensed the disturbance and left the place 36 min before the kill. Dholes walked scenting the ground. Dholes drank frequently while eating.
4.	27 Sept. '76	0615-0730	Clear day Ministergutti-Chammanahalla road	5+	Chital doe	Flight doe escaped	-do-	—	—	—	—	—	—	Dholes walked scenting the ground. Sounds in the scrub indicated the progress of the hunt.
5.	2 Nov. '76	0800-0900	Clear day North of Thavarakatte	7+	Sambar fawn	Flight	Extended line formation + flushing prey to interceptors	< a minute; 30 to 40 m	0830; our presence disturbed the dholes	Evisceration, wound on the rump	15+min	Kill was dragged into bush, later stolen by a local man	Nil	Before the intercepting dholes could reach the fawn was seriously injured. Sounds in the scrub indicated the progress of the hunt.
6.	17 Nov. '76	0635-0815	Clear day Karaimarakolachi	4+	Pregnant chital doe	Flight	Outright chase; dholes ran faster than the doe	Not recorded	0641; < 1 min	Wound on rump and belly	—	49 kg. One eye was removed. One ♂ dhole dragged away the kill	10+ crows came at 08 0	Two sambar does called when they saw dholes. Kill was made by a dhole other than 'Bent Ear'. Local people prevented dholes eating.
7.	22 Nov. '76	0730	Cloudy, Bandipurkere	7+	Pregnant chital doe	Not recorded	Not recorded	-do-	0730; (Time of attack)	Wound on the left eye, snout, belly, rump and thigh	—	44 kg.	—	Hunt was disrupted by the tourists.

TABLE 1 (contd.)

8	18 Feb. '77	1530-1730	Rain, Kembikallugudda	7	Chital fawn	Flight	Extended line formation	< 1 min, < 100 m	1721; within few seconds	Torn to pieces	5+min	Nil	Nil	Before the hunt dholes rested on a defecation site. Dholes moved scenting the ground One dhole lagged behind eating. As soon as the kill was made a dhole ran away with a chunk of meat.
9	24 Mar. '77	1730-1840	Clear day, shooting hide	7	Chital ♂ 90 cm hard antler	Not recorded	Not recorded	Not recorded	1735; 15 min	Evisceration, ate the stag alive	115+min	40 kg. dragged viscera away; testicles, without skin, lay closely	3 to 5 crows	The stag was easily subdued by nose-hold. It ineffectively used the antlers. Dholes were wary of the antlers and the observer.
10	6 May '77	0630	cloudy, Thavarakatte	15	Chital ♂ 84 cm hard antlers	Tried to run to the pool	-do-	-do-	0630	Wound on the rump	Not recorded	Not recorded	4 to 5 crows	The stag fell 10 m from water. It was followed by 'Bent Ear'.
11	27 May '77	0730-0930	Clear day, Kolakmallikatte	15	Chital doe	Not recorded	-do-	-do-	0730	Not recorded	120 min	10 kg.	Nil	Two dholes killed. Neither was 'Bent Ear'. One dhole went and brought others. Dholes frequently drank. Kill was dragged into bush.
12	30 May '77	1745-1900	Clear day, Thavarakatte	15	Chital fawns (2)	-do-	-do-	-do-	Kills were made at night	-do-	Not recorded	Not recorded	Each fawn skull was attended by a crow	Dholes smelt me when I was 100 m away. When they reached a place frequented by chital even pups' scenting the tracks became frantic.
13	21 July '77	0700-0755	Cloudy, Thavarakatte	15	Chital fawn	Ran into a pool	Uncertain	c 300 m	0713; < 1 min	Evisceration, dragged the viscera away	around 40 min	-do-	8-10 crows	'Bent Ear' swam to the fawn jumped on to its back and pulled it ashore holding the nose. Others helped killing on the shore.
14	31 July '77	1713	Clear day, shooting hide	15	Chital fawn	Flight	Outright chase	< 200m	1713; within few seconds	Torn to pieces	40 min	Could not be found	21 crows	A pea cock in full train, landed 10 to 15 m from a dhole. The latter did not chase it.
15	26 Aug. '77	1730-1755	Clear day, shooting hide	15	No Kill	—	Flushing prey to waiting dholes	—	—	—	—	—	—	Dholes had killed a chital fawn in the morning. No prey was flushed in the evening.

TABLE 1 (contd.)

16	18 Sep. '77	1715-1800	Cloudy, teak plantation	16	Sambar fawn	Not recorded	Extended line formation	c 50 m	1755; within few seconds	Not recorded	5 + min	Jaw	Nil	At the beginning dholes went in single line. One lagged behind eating a bone.
17	19 Oct. '77	1700	Rainy, Chammanahalla road	3	Sambar fawn	-do-	Not recorded	Not recorded	1700	Wound on rump and flank	5 +	13 kg. Eyes were removed	20 crows	Chital, although 500 m away from the kill, sensed disturbance and ran away. Dholes dragged the kill for 40 m.
18	24 Oct. '77	0910-0925	Clear day, Bandipurkere	10+	Chital fawn	-do-	Extended line formation	< 50 m	0915	Not recorded	10 min	Nil	6 to 7 crows	While searching for the jaw a chital fawn was flushed almost from the same place where the dholes were eating.
19	3 Nov. '77	0705-0810	Clear day, Thavarakatte	16	Sambar fawn	Not recorded	Flushing prey to waiting dholes, extended line formation	c 10 m	0800, within seconds	Not recorded	10 min	Nil	Nil	Three sambar (2 does + 1 yearling doe) walked through dholes. Later 2 does chased 3 dholes watched by 2 yearling does.
20	20 Nov. '77	0740-0800	Cloudy, Kerigowdanakatte	16	Hunt was not successful	Sought refuge in water. 2 does + 1 two year old stag +1 fawn stood rumps together	Not recorded	—	—	—	—	—	—	Fawn screamed while running to water. Adults kept the dholes away by beating the water with forelegs.
21	22 Nov. '77	1510-1758	Clear day, Kirubanakolachi	10+	-do-	An adult sambar doe + 1 yearling doe + 1 fawn ran into pool Stood rumps together	-do-	< 200 m	1615	—	—	—	—	The sambar fawn screamed while running to the pool. The does kept the dholes away. Sambar stayed in water for 40 min even after the dholes left. Dholes played near one of their latrine sites before killing a chital fawn.
22	11 May '78	1605-1700	Cloudy, lightning + thunder, Thavarakatte	15	No kill	Chital bunched	—	—	—	—	—	—	—	Next morning 2 chital fawns were killed.

TABLE 1 (contd.)

23	21 June '78	1500-1600	Clear day, Karaimarakolachi	7?	Chital ♂ 81 cm hard antlers	Flight	Chase	300 m	1500	Evisceration	Not recorded	30 kg.	Nil	Nose-hold.
24	3 July '78	0650-0800	Clear day, Mysore lodge pond	13 +	Chital ♂, 45 cm hard antlers	Not recorded	Fxtended line formation	< 300 m	Not recorded	Not recorded	Not recorded	1+kg. Eyes removed, viscera lay 4 m from the kill	1 crow	One dhole ate *Lantana* leaves; 'Limper' stayed for an additional 10 min eating the remains.
25	27 July '78	1745-1748	Cloudy, Kirubanakolachi	4	Hare	Ran in circles	Chase	< 100 m	1745	Could not be observed	3 min	Hair	Nil	—

APPENDIX II

Estimation of number of kills from scats

Dhole

This aspect of research is difficult as bias could occur from the following:

a) an adult sambar can provide two meals for the pack and two sets of scats can be derived from one kill;

b) young chital fawn or hare could be eaten by one member of the pack and a random collection of one or two scats from the scat group may not represent the prey eaten;

c) confusion over differentiating hair of big fawn from that of young adult.

Assumptions: The following assumptions were made:

a) the mean size of the pack including pups was 13;

b) two chital fawns (average weight 15 kg, an average of 81 kills) or one sambar fawn (average weight 32 kg, an average of 34 kills) or 12 hare (average weight of each 2 kg) or 240 rodents (average weight of each 100 gm) are needed to provide the pack its minimal rate of 1.86 kg meat per dhole per day. It is not possible, however, for the pack to feed exclusively either on hare or on rodents;

c) there was much variation in the contribution of stolen kills to the scat formation; chital adults in Bandipur hardly provided more than one meal (138 kills gave 134 scats or 1 kill provided 0.97 meals or scat groups) (See Table 22).

Deriving expected kills: There was discrepancy between observed and expected kills. The observed kill of adult sambar was 10 and the expected kill based on the assumption that a kill gave 2 sets of scats (18 scats were collected) should be 9. Entire adult sambar was not stolen. On 5 occasions dholes ate sambar kills for the second time (10 sets of scats). Once part of a tiger kill (a prime adult sambar stag in velvet) was eaten (1 set of scats). Two sambar kills, before dholes could feed on them for the second time, were stolen (2 sets of scats). All these accounted for 13 scats and the rest 5 could have been derived from 2.5 or 5 kills. Hence it was assumed that the number of adults killed was between 9.5 (10) and 12.

Adult chital remains were seen 127 times and as one kill could give 0.97 scats the expected kill would be 131 and the number derived was also 131. This is explained as follows. Total number of adult kills dholes ate was 138 and of this 4 were of leopard (Table 22). The observed dhole kills, therefore, were 134. Scats produced from the total kills eaten should be 134 (113 scats from 113 kills eaten once, 14 scats from 7 kills eaten twice and 3 scats from 6 partly eaten kills and 4 from 4 leopard kills). While calculating the expected dhole kills from scats 4 scats derived from leopard kills and 7 from dhole kills eaten twice should be deducted. This gives 123 kills and with the addition of 8 kills stolen figure 131 is derived.

There is a difference of 3 between the observed (134) and expected kills (131) of adult chital. This may be due to the failure to collect the representative samples of all scats or misclassification of yearlings as big fawns.

While correlating sambar fawn remains in scats with the kills a difference of 8 was found. It is possible that dholes may have scavenged on large sambar fawn kills for the second time or they would have eaten the kills of other predators or it may have been due to the inability to collect all the sambar fawn kills.

Within my knowledge 3 chital fawn kills were stolen and dholes may have eaten much of the fawns before they were removed. Dholes scavenged on 2 chital fawn kills of leopard. If chital fawn remains were seen 143 times in the scats the minimum expected kill should be (143 × 2) 286.

Correction factor and corrected estimates of kills: Another correction was made to account for the representative scats not collected. This was based on the assumption that the number of scats with adult sambar remains was equal to the number of scat groups produced by the dholes with adult sambar remains. The average of minimum (10) and maximum (12) adults killed was 11. Of these 2 kills gave rise to 2 sets of scats and the other 9 could have led to 18 scats. One set of scats was derived from the tiger kill and so 21 sets of scats with adult sambar remains may have been produced and 18 were collected. Hence the correction factor 21/18 or 7/6 was applied to assess the corrected estimate of number of scats and kills (Table 14).

The application is explained as follows: There were 54 scats with sambar fawn remains and the corrected estimate of scats was (54 × 7/6) 63 and the corrected estimate of kills 63. The corrected number of scats with chital adult remains was (127 × 7/6) 148, which could be derived from (131/127 × 148) 153 kills. Floyd *et al.* (1978) have found that 0.41 kg of snow shoe hare can form one wolf (*Canis lupus*) scat. If this is applicable to black naped hare — dhole feeding interactions 3 hares can provide enough food for each pack member to produce one scat. There were 74 scats with hare remains which means a minimum of (74 × 3) 222 hare were killed and the corrected estimate of scats would be (74 × 7/6) 86 and the corrected estimate of kills (86 × 3) 258.

As small prey are composed of relatively more indigestible matter (Floyd *et al.* 1978) each rodent remains could be voided out as one scat. Thirty four scats with rodent remains were collected and it is estimated (240 × 34) 8160 rodents were killed. The corrected estimate of scats containing rodent remains was (34 × 7/6) 40 and the corrected estimate of kills was 240 × 40) 9600. Biomass of prey killed was calculated based on the estimated number of kills.

Tiger

As the sample size of collected scats of tiger and leopard was smaller than that of dhole sampling error is likely to be inflated. Therefore, I resorted to specifying 95% confidence interval. In both cases collected sambar kills and scats with adult sambar remains were used as the basis for estimating the corrected estimate of expected kills. The reason for this was all the adult sambar kills were collected and the possible number of scats resulted from the kills and the number collected in the field could be used to derive a correction factor. This could aid in estimating the corrected number of scats and kills. It was assumed that:

a) an adult sambar can give 4 full meals either to a tiger or a leopard;
b) a full meal was eaten once a day;
c) each meal resulted in one pile of scats.

Six adult sambar killed by tiger were collected and as one kill was partly scavenged by dholes the expected number of scats was 22. Number of scats collected was 2, 6% of the total 35 scats (one scat entirely of earth is not included in the calculation). The expected proportion of scats with sambar remains should have been between 1% and 22% or 0.35 and 8 scats with 95% confidence. From this a correction factor of 3 and 63 was derived by dividing the corrected estimate of 22 scats by 8 and 0.35. This correction factor was used to find the corrected estimate of scats and corrected estimate of expected kill with 95% confidence (Table 16).

The corrected number of scats with sambar fawn remains was between 27 and 567, with chital adult between 18 and 378 and with chital fawn between 24 and 504. The expected kill of sambar fawn was between 18 and 378 (1 sambar fawn can give 1.5 meals or lead to 1.5 piles of scats and 27 scats can be derived from 18 kills), chital adults between 9 and 189 and chital fawns between 24 and 504 etc. Regular search for the kills led me to conclude that kills of tiger were near the lower estimate.

Leopard

One yearling ♂ sambar (age class III) killed by a leopard was collected. It was estimated to have weighed 130 kg and could have provided 4 full meals and consequently 4 piles of scats. Two scats were collected that contained adult sambar remains. One was probably from a kill and the other, I concluded, was due to scavenging. These 2 scats constituted 3% of the total 66 scats (4 scats with cattle remains are not included in the calculation). Using 95% confidence limits the proportion of scats with the sambar remains should have been between 1% and 8% of the total 66 scats or 1 and 6 scats. Correction factors of 0.8 and 5 were derived from this for the upper and lower bounds by dividing the corrected estimate of 5 scats with 6 and 1.

The corrected estimate of scats based on 95% confidence and the corrected estimate of expected kills were calculated (Table 15). Examples:

a) a sambar fawn can give 2 meals and there were 8 scats with sambar fawn remains. When multiplied by the correction factors 0.8 and 5 the corrected estimate of 6 to 40 scats was obtained. The corrected number of kills was 3 to 20;
b) three hares can give a full meal to a leopard. There were 8 scats with hare remains and the corrected estimate of scats was 6 to 40. The corrected number of kills was 18 to 120. I assumed that the number of leopard kills was near the upper limit.

APPENDIX III

ESTIMATION OF THE EFFECT OF PREDATION AND STEALING KILLS ON CHITAL POPULATION

The following details are necessary for the calculation:

(a) the number of chital fawns killed averaged 224 for one year (167 by dhole, 45 by leopard and 12 by tiger) and the corresponding figure for adults was 95 (Tables 14, 15 and 16);

(b) during May, June and July 1977 there were 333 does and 224 fawns on the average (Table 2). Total fawns produced in 1977 was 448 and the fertility rate of does (333) was 1.3;

(c) the mortality rate was (448/224) 0.5. The life span of a chital as a fawn is 6 months after which it becomes either a spike ♂ or a yearling doe. During a year if 100 fawns are seen and 50 are killed it means in 6 months there must have been 50 fawns and 25 kills giving 0.5 survival for 6 months;

(d) sex ratio at birth was even and the survival rate of ♀ fawn was 0.54 and of ♂ fawn 0.46. This estimate was based on adult sex ratio in the population (84 ♂♂ : 100 ♀♀);

(e) annual adult mortality rate (0.13) was calculated by dividing the total adult kills (95) by the total adult number (95+612) 707. (Six hundred and twelve is an average of May, June and July 1977 adult ♀ number). Adult mortality rate for 6 months was 0.07 and survival rate 0.93;

(f) One adult kill (average weight 57 kg) is equivalent to 3.8 fawns.

I assumed that there were 100 does. In 6 months 7 will die and 93 will survive. In 6 months 100 does can give birth to $\left(\frac{100\times 1.3}{2}\right)$ 65 fawns and at an even sex ratio there will be 32.5 ♀ fawns and at a survival rate of 0.54, 18 fawns will grow into does and at the end of 6 months with the existing predation rate the number of does would be 111.

The same calculation was projected for ♂♂ whose population based on adult sex ratio was assumed to be 84. The survival rate of ♂ fawns is 0.46 and (32.5 × 0.46) 15 fawns will grow into spike ♂♂. By the end of 6 months ♂ number (84) with the survival rate (0.93) would be 78. With the addition of 15 animals it would increase to 93 giving a growth rate of 11% for 6 months and 23% for one year. The same growth rate was also seen in the case of does.

Stealing of kills and chital population: Calculations are projected here to assess what would happen if 50% of adult chital kills were stolen. This would increase predation rate on both fawns and adults. A total of 585 fawns (95 × 3.8 + 224) would be killed under these circumstances. If 50% of adult kills were stolen (47.5) and if dholes compensated their loss by preying exclusively on fawns then 181 additional fawns (47.5 × 3.8) would be killed. When the probable number of additional fawns killed was calculated (181 × 224/585) 69 was obtained. The likely number of adults killed with reference to total converted fawn number (585) and fawn number derived from 95 adult kills (361) would be (47.5 × 361/585) 29. With the additional adult kill the annual mortality rate would be (95 × 29/707) 0.18 and survival rate 0.82 and survival rate for 6 months would be $\sqrt{0.82} = 0.91$. Fawn mortality rate would be (224 + 69/448) 0.65 and survival rate 0.35. The survival rate of ♀ fawns (0.35 × 54/50) would be 0.38 and ♂ fawns (0.35 × 46/50) 0.32.

With the increased mortality rate 100 does will be reduced to 91 at the end of 6 months. At the fecundity rate of 1.3 100 does can produce 65 fawns by the end of 6 months. Of this 32.5 will be ♀♀. With the given ♀ fawn survival rate (0.38) 12 fawns will grow into does and at the end of 6 months there will be 103 does. Growth rate of ♂ population will be of the same order and on the average at the end of 6 months the population would have increased by 3%. When uncontrolled scavenging by man removes > 50% of kills to the population will decline in the long run.

APPENDIX IV

ESTIMATION OF THE EFFECT OF PREDATION AND STEALING OF KILLS ON SAMBAR POPULATION

The following particulars are necessary for computation:

(a) on the average in a year there were 51 fawn kills and 9 adult kills (Table 14, 15 and 16);

(b) age and sex ratio of the population, averaged over the period May, June and July 1977 and 1978 had 58 adult and yearling does and 8 yearling ♂♂ (Table 4). Percentage of yearling ♀♀ in the population was assessed to be 8. Hence the percentage of adult ♀♀ in the population would be (58 - 8) 50. Based on this the adult doe number in July 1977 population (160 to 180, average 170) was calculated to be 85. During May, June and July 1977 and 1978 the average fawn: doe ratio was 36: 100 or 85 does had 31 fawns. With this the total fawn killed (51) was added and the fecundity of does was calculated to be (82/85) 1.

(c) by considering total fawn production (82) and fawn mortality (50) the mortality rate of fawns was calculated to be (50/82) 0.6 and the survival rate 0.4;

(d) fawns after 6 months were considered either as spike ♂♂ or as yearling does;

(e) survival rate of both ♀ and ♂ fawn is supposed to be 0.4;

(f) more yearling and adult ♂♂ were killed than ♀♀ (see discussion: predation and sex of prey). Total kills collected were 17 (9 ♂♂ + 8 ♀♀) and based on scat data it was assessed that on the average 9 adults were killed in a year (see estimation of number of kills from scats). If the sex ratio seen in the kills is projected for the 9 kills derived from scat study a ratio of 5 ♂♂ : 4 ♀♀ is obtained;

(g) total adult sambar in the population was 134 (79% of the population was adult and in July 1977 there were 160-180 animals or 170). Number of adult ♂♂ and ♀♀ in the population as per the sex ratio (41 ♂♂ : 100 ♀♀) was 39 ♂♂ and 95 ♀♀;

(h) annual adult ♂ mortality rate (0.11) and survival rate (0.89) were calculated by dividing ♂ kills (5) by the total number of ♂♂ in the population (39 + 5) 44. Annual adult ♀ mortality rate (0.04) and survival rate (0.96) were derived by dividing doe kills (4) by total does in the population (95+4) 99.

I assumed that there were 100 does. In 6 months 2 of these will die. In 6 months 100 does can give birth to (100 × ½) 50 fawns. At an even sex ratio 25 will be ♀♀ and with a survival rate of 0.4 10 fawns will be added and there will be 105 does. This is an increase of 8% in 6 months or 17% in one year. If calculations are made for ♂♂ with the assumption that 41 ♂♂ were present at the beginning at the end of 6 months with the survival rate of $(\sqrt{0.89})$ 0.94, 39 will survive. Male fawn survival will be (0.4 × 25) 10 and adult ♂♂ at the end of 6 months will be 49 and the growth rate will be 8% for 6 months and 17% for one year.

Stealing of kills and sambar population: Stealing an adult sambar kill is difficult and it is speculated that mostly fawn kills were stolen. An assessment is made here to know what would happen to the population if 50% of the fawn, kills is stolen. It is presumed that in the absence of many adult sambar kills additional mortality will be borne by fawns. If this is the case, fawn mortality rate would be $\left(\frac{51+25}{82}\right)$ 0.93 and survival rate 0.07. This survival rate is the same for the ♂ and the ♀ fawns.

Hundred does in 6 months would be reduced to 98 and would produce (100 × ½) 50 fawns of which 25 will be ♀♀ and 25 ♂♂. At the survival rate of 0.7 2 animals will be added to the population and the doe number would be 100 showing no growth rate. In the case of ♂♂ (41) with the survival rate of 0.94, 39 will survive and at the survival rate of 0.07 2 ♂ fawns would grow into spike ♂♂ and the ♂ population at the end of 6 months will be 41 indicating no growth rate. This indicates that sambar population can be seriously suppressed by the stealing of kills.

AN EAST-WEST *AQUILA* EAGLE MIGRATION IN THE HIMALAYAS[1]

ROBERT L. FLEMING JR.[2]

An autumn east-west *Aquila* migration in the Himalayas is reported in detail for the first time. *A. nipalensis* predominates with *A. clanga* and *A. heliaca* also occurring. The migration period lasts for more than a month. A high count of 275 birds per hour is reported and a minimum estimate indicates that over 45,000 birds may be involved. The migration has been noted at different points over a distance of some 1000 kilometres (from Dzongri, Sikkim to Naini Tal, Kumaon). Where these birds winter is unknown.

INTRODUCTION

That many birds from accentors to cranes and geese migrate across the Himalayas in a north-south direction is well known (see Fleming, Fleming and Bangdel 1979:13), although how high most of the birds fly while crossing the chain, at what points they actually pass over the crest, and in what numbers they appear needs much additional investigation. That some raptor species, notably *Aquila* eagles, use the Himalayas as an east-west pathway, moving westward in a steady stream during the autumn has remained largely unreported although Hutton in Mussoorie and Donald near Dharamsala mention sightings (Donald 1924: 1054-1055). While our current understanding of this *Aquila* migration is still far from complete, we present our data hoping to encourage additional study of this phenomenon.

OBSERVATIONS

The initial first-hand information that eagles migrate from each to west in the Himalayas was gathered on 28 Oct. 1971 during a visit to the delightful Lariya Kanta Hill [elevation just over 2440 m (8000′)] five kilometres north-east of Naini Tal in the Kumaon Himalayas. While sitting on top of this hill, we noticed an *Aquila nipalensis* circling in the east below us. It rapidly gained height, soaring quite near, and then glided away to the west. This was at 12.30 hrs. Then we found a group of six birds that again started out below us but rose on broad wings to pass nearby and glide west. More followed. In the first hour of observation, 17 *Aquila* eagles passed our field of view. Between 13.30 and 14.17 hrs (47 min.), an additional 36 birds appeared. At 14.17 the clouds, already building for some time, enveloped us and obscured further observations. All birds as far as we could tell were *A. nipalensis.*

Subsequently, in 1975, my father, R. L. Fleming, Sr., noted a similar concentration of *Aquila* eagles in late October on a ridge called "Two Trees" at the southern edge of the Kathmandu Valley. On this occasion he spotted, at about 10.30 hrs, some 16 birds approaching from the east. They soared near him and then glided west along the north side of the Chandragiri ridge. About 30 minutes later he noted a "rather haphazard" collection of some 30 birds following in exactly the same manner. These were identified as *A. nipalensis.*

Similarly, on 19 Nov. 1975, we noted eagles along the northern edge of Kathmandu Valley

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where they circled over the Shivpuri monastery and then glided to Ahale Dara above which they soared again to gain height. A total of 44 birds were counted between 11.13 and 12.13 hrs.

Thus we were aware that *Aquila* eagles migrate from east to west, but were unprepared for the numbers that appeared during a visit to the Annapurna area, Central Nepal in the autumn of 1976. On this occasion, we were climbing towards the Dhampus ridge from Suikhet valley when at about 16.00 hrs on 31 Oct. we noted 17 eagles circling closely overhead. The eagles were at about 1708 metres (5600′) with heavy clouds above them.

That night we camped on the Dhampus ridge and the following morning (1 Nov.) kept an early and sharp lookout in the direction where the eagles had been seen the previous evening. But as we saw no further activity, our attention was drawn to the nearby forest.

Early on the morning of 2 November we shifted our operations to a campsite one kilometre further north and suddenly spotted eagles. They appeared on a route approximately three kilometres north of where we had been them on 31st Oct. During these observations (see Table 1). the weather remained clear and the eagles passed over within about 305 metres (1000′) of the ridge, flying at an estimated altitude of between 2745 metres (9000′) and 3050 metres (10000′). Three species of eagles appeared to be represented.

We continued our observations on 3 and 4 November and noted the following concentrations (numbers of birds here reflect totals for the time period, not aggregations of large size travelling together).

TABLE 1

Location: Dhampus, Central Nepal	*Date*: 2 Nov. 1976
Time of Day	Numbers of eagles divided into the sizes of the groups as they passed
9.55 to 10.00	2, 11, 2
10.00 to 10.05	2, 4, 3, 2
10.05 to 10.10	9, 1, 20, 4, 4
10.10 to 10.15	6, 3, 8, 1, 5, 1, 1, 1
10.15 to 10.20	2, 1, 2, 2, 1, 2, 1, 2
10.20 to 10.25	6, 1, 2, 3, 5, 2, 4
10.25 to 10.30	1, 18, 2, 1, 11, 3, 4
10.30 to 10.35	2, 1, 1, 7, 5, 1
10.35 to 10.40	6, 2, 6
10.40 to 10.45	2, 1, 11, 3, 10, 2, 9, 6, 1
10.45 to 10.50	6, 3, 4, 1
10.50 to 10.55	4, 2, 9, 3, 1
10.55 to 11.00	10, 3, 6, 6, 7
Total of the above: 275 in 1 hr; 307 in 1 hr 5 min.	
15.30 to 16.10	2, 5, 2, 1, 4, 17, 3, 1, 2, 1, 4, 3, 2, 1
Total of 48 birds in 40 min.	
03 Nov. 1976, Dhampus, central Nepal	
9.10 to 9.30	36 birds
9.30 to 9.45	66
9.45 to 10.00	43
Total of 145 birds in 50 min.	
First bird of the day seen at 9.10	
04 Nov. 1976, Dhampus, central Nepal	
15.10 to 16.10	131 birds
Last eagle seen at 16.30	

By 5 November we had noted that in this general area, eagles used three different routes, depending on the time of day. At first, eagles passed far to the north, close to the snow peaks. But when cloud buildup covered the northern route, they moved to a "middle" section (the Dhampus ridge) which they used until clouds forced them to a southern flyway (the Kaski ridge). On 5 November, the shift from the middle to the southern route occurred between 15.55 and 16.00 as the following data shows:

5 Nov. 1976, Dhampus, central Nepal; observations on the "middle route":

15.40 to 15.45	18 birds
15.45 to 15.50	8
15.50 to 15.55	1

none after 15.55 hrs.

Observations on the "southern route":

No birds noted prior to 15.55

15.55 to 16.00	7 birds
16.00 to 16.05	8
16.05 to 16.10	25
16.10 to 16.15	33

Last bird seen at 16.14 (sunset at about 17.00 hrs)

6 Nov. 1976, Hanja, central Nepal; observations on the "southern route":

15.00 to 15.05	18 birds
15.05 to 15.10	6
15.10 to 15.15	11
15.15 to 15.20	7
15.20 to 15.25	6
15.25 to 15.30	7
15.30 to 15.35	3
15.35 to 15.40	3
15.40 to 15.45	5

Last bird seen at 15.44

Total of 66 birds in 45 mins.

In October 1978 we found a north-south migration along the Kali Gandaki valley near Lete. These eagles circled over Lake Titi area and then, crossing the Kali Gandaki, they continued around a spur of Dhaulagiri, staying close to the mountainside. On the same day, we again observed numbers circling about the cliffs immediately above Ghasa. From here the birds glided away in a south-south-west direction and would likely join the main east-west stream somewhere southeast of Dhaulagiri.

Observations in the Kali Gandaki valley, near Lete, 24 Oct. 1978:

10.30 to 10.45	27 birds
10.45 to 11.00	26
11.00 to 11.15	23

Total of 76 birds in 45 mins.

We have very little data from the eastern parts of Nepal or from the eastern Himalayas. Phil Hall and Jack Cox reported that on the 13th of November 1978, between 12.00 and 13.00 hrs they noted 10 eagles circling over the ridge above Ilam, eastern Nepal, and then gliding west. These were identified as 8 *A. nipalensis* and 2 *A. clanga.*

On 3 Nov. 1980 we noted five *A. nipalensis* soaring at about 12,500′ over the Dzongri ridge in western Sikkim. No further sightings ensued.

In addition, we have scattered observations of eagles moving south along the Arun river valley as well as the Dudh Kosi valley, both in eastern Nepal.

REMARKS

From the foregoing data, it can be seen that an east-west *Aquila* eagle migration occurs in the Himalayas in the autumn. The birds use updrafts to gain height and then glide to attain horizontal distance. The exact route used (specific hilltops and ridge lines) does not remain static, but varies according to local cloud build up. Himalayan autumn days usually begin with clear skies but by mid-morning clouds appear that by late afternoon may develop into towering thunderheads. Eagles avoid these clouds and the change of route, in the Annapurna area, is from Machapuchare to over Pokhara Bazaar, an estimated shift of about 8 km.

Eagles begin flying just after 9.00 hrs and this coincides with the beginning of sun-generated updrafts. The migration continues fairly steadily throughout most of the day. Most birds moving after about 16:00 hrs need to beat their wings in order to maintain altitude and migration ceases for the day at about 16.30 (with sunset at about 17.00 hrs). Eagles passed as single birds or in groups of up to twenty individuals.

As for the "flow rate" of the migration, we noted (on 3 November) 145 birds in the first 50 minutes of the period which would allow approximately 174 birds per hour. At the end of the day, on 4 November, we observed 171 birds in the final 1 hour and 15 minutes which equates with about 137 birds per hour. The highest count recorded was of 275 birds per hour between 9.55 and 10.55.

In discussing total numbers of eagles involved in this migration, we are on shaky ground. But if we allow an average of 200 birds per hour over a seven and a half hour span, this gives a total of 1,500 birds per day. The migration lasts for at least 38 days (24 Oct. to 30 Nov.) and very likely carries over to about 45 days, so that using a conservative figure of 30 days multiplied by 1500 birds, we reach a total of 45,000 individuals. Also it should be noted that these figures are based on sightings from the Pokhara area of Nepal. Thus all the eagles coming down the Kali Gandaki valley (i.e. about 100 in an hour) would join the main flow west of Pokhara and would not be included in the 45,000. While these figures are extrapolated from grossly insufficient data, they do show considerable movement and indicate that a further detailed study of this phenomenon is much needed.

The exact species composition of this migration is yet to be determined. Certainly three species take part: *A. nipalensis*, *A. clanga* and *A. heliaca* with the majority appearing to be *A. nipalensis.* Eagle identification can be difficult and we were unable to determine exact percentages due to the speed of the migration, the distance of many birds from the observer, and unfavourable sighting angles.

Curiously, this migration appears to be restricted almost entirely to *Aquila* eagles. On one occasion we saw two Hen Harriers (*Circus cyaneus*) with the eagles and one time a Eurasian Buteo (*Buteo buteo*) came past, but the eagles remained surprisingly free of migratory associates. In many cases, various vulture species also used the updrafts and while the vultures were not on migration, one had to be careful to distinguish eagles from vultures when counting birds at a distance.

Most birds appear to be coming from the direction of Tibet. Besides the sightings in the Kali Gandaki valley, we also noted birds in the Arun and Dudh Kosi valleys. It is likely that the eagles cross the Himalayas on a broad front, using valley systems as navigational aids, and then join forces for a mass westward progression.

Where these birds are going we do not know. In winter on the plains of India one sees some *Aquila* eagles but unless there is some as yet undiscovered concentration of eagles in the subcontinent, it is hard to see where 45,000 eagles might winter. Africa appears to be a favourite wintering ground for *A. nipalensis* and the eagles are common in east and central Africa (Williams 1963: 55) and they occur as far south as South Africa (McLachlan and Liversidge 1978: 99). Might our Himalayan eagles not be going to Africa? In the autumn and spring we frequently see little knots of the Redfooted Falcon (*Falco vespertinus*) and the Lesser Kestrel (*Falco naumanni*) as they pass through from China to Africa (and reverse in the spring). Possibly the eagles are following suit?

We have been discussing an autumn migration; curiously we lack figures for any concentrated form of *Aquila* migration in the spring. We do note scattered birds in high altitude valleys (such as in the Everest National Park) in spring, but have never seen substantial numbers. Obviously a great deal of additional investigation will be necessary before we will be able to determine the full extent of this *Aquila* migration.

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A CATALOGUE OF SPECIES ADDED TO GAMBLE'S "FLORA OF THE PRESIDENCY OF MADRAS"[1]

S. Karthikeyan and B. D. Sharma[2]

Sebastine (1962), Sebastine and Ramamurthy (1966) and Karthikeyan (1971) have compiled the species that have been added to Gamble's "Flora of the Presidency of Madras". In the present list 6 genera, 403 species, 10 subspecies, 61 varieties and 4 forma have been enumerated.

Gamble's "Flora of the Presidency of Madras" covers the present States of Andhra Pradesh, parts of Karnataka, Kerala and Tamil Nadu. A total of 4516 species have been described from these areas, (Gamble & Fischer, 1915-1936).

Since the publication of the Flora many new species and new records have been described from this area. Sebastine (1962), published a list of 80 such species. Sebastine and Ramamurthy (1966) further enumerated 47 species. Karthikeyan (1971) listed 78 grasses alone.

Since then many species have been added to this area and the publications are scattered. All such information has been gathered here to be of use to research workers on taxonomic botany in general and of this area, in particular. Some species which have been recorded earlier and did not find a place in earlier lists have also been included here.

A total of 6 genera, 392 species, 10 subspecies, 61 varieties and 4 forma have been enumerated here. They have been arranged in the same family sequence as that of Gamble's 'Flora'. Under each family, the species have been arranged alphabetically. The names of species have been followed by original citation of publication in case of new taxa only. For new records reported from this area as new for India or for the region alone, the publication reporting it is cited and not the original publication. The abbreviated name of the State from where the species have been collected has been given. The following abbreviations have been used to save space.

AP. : Andhra Pradesh
K. : Kerala
KA. : Karnataka
TN. : Tamil Nadu

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STUDIES ON SPAWNING MIGRATION AND SPAWNING OF HILLSTREAM FISH *DISCOGNATHUS MULLYA* (SYKES)[1]

G. LOVIAH JOSEPH[2] AND S. V. JOB[3]

(*With a text-figure*)

INTRODUCTION

Migration of fishes from their native habitat prior to spawning to another area, which may offer favourable conditions for spawning, and their subsequent return to their original home has been recorded in many riverine forms (Cadwallader 1976), and first migration of *Discognathus* was reported by Hora (1921). An excellent account of the prespawning migration of *D. mullya* was given by Jones (1941), who observed the migration of this species in the Kallar river of Western Ghats in Peermedu Taluk, Travancore.

In this study the migration of *D. mullya* was investigated in a hillstream called Ulakkaruvi, situated at an altitude of 1255 m above MSL in the southern slopes of Western Ghats in Ashamboo hills of Kanyakumari District, Tamilnadu. This hillstream has two major water falls — upper and lower, several pools and rapids.

MATERIAL AND METHODS

An area of approximately 1 Kilometre from upper falls down to the lower beds of the Ulakkaruvi stream, embracing several pools and rapids was taken up for study. The area taken for observation was divided arbitrarily into three major zones (Fig. 1) for convenience and the study was carried out from November 1977 to March 1978. The area of the upper falls lying at an elevation of 614 m above MSL has two major pools and ten rapids, called zone A, while the lower falls (537 m above MSL) and area around it including a side stream constituted zone B. In this area, there are five medium sized pools and nine rapids. Zone C consisted of the lower reaches of the main stream lying at an elevation of 502 m above MSL. Here there are three pools one major and the other two medium sized, and five rapids.

Preliminary investigations were carried out in the laboratory to find out a suitable marking method on the fish so that they could be easily identified on recovery. Tagging (plastic) of either the operculum or fin was found to be unsuitable, since the tagged fishes behaved abnormally, and there was considerable mortality. This method was abandoned and a group marking technique (Nikolsky 1963, Brian Stott 1971) was adopted. Group marking is performed either by painting or branding the fish, or by cutting part of the fin, was found to suit well for *Discognathus* and hence this method was employed, and the following procedure was followed in the field.

Fishes were captured in the early hours of the day (8 a.m.), and those with length range

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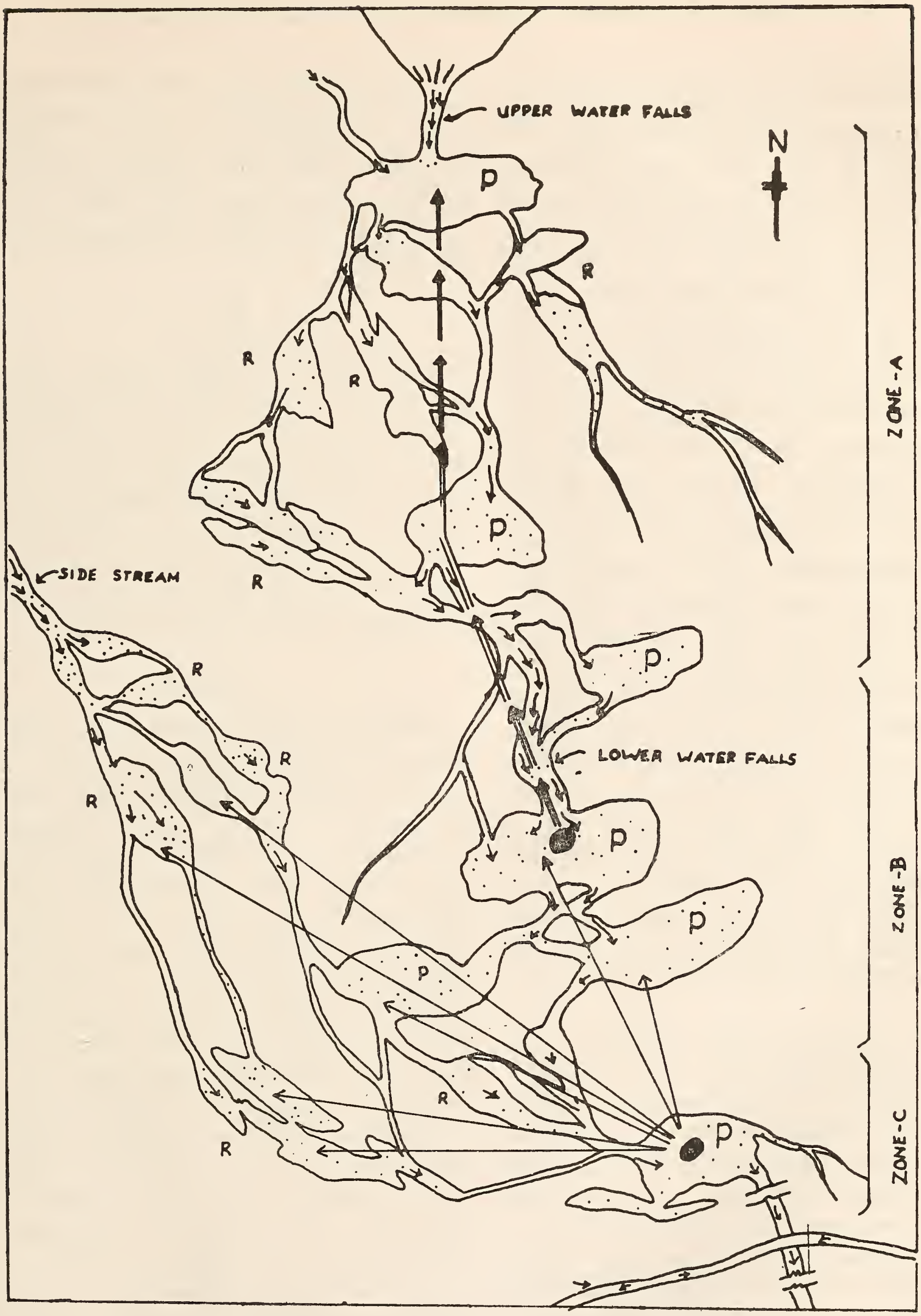
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P
R
LOWER WATER FALLS
R
P
ZONE-B
P
P
R
R
P
ZONE-C

Fig. 1. Showing a section of the Ulakkaruvi stream probed in migration studies.
P — Pools R — Rapids

Arrows radiating from the pool at Zone-C indicate the direction and areas of prespawnal migration.

Arrow from pool at Zone-B towards Zone-A indicate the direction of post-spawnal migration.

Small arrows inside the pools and rapids show the direction of the flow of water.

55 mm and above were only taken for study. The netted fishes were released in net cages (3 x 1 m) kept half submerged in a pool. From this sample the fishes were taken individually in a small hand dip net; its length was measured and the dorsal lobe of the caudal fin was spread and the postero-dorsal edge (> 3 mm) was clipped off. On the amputated surface methylene blue solution was rubbed using cotton. The marking was done as rapidly as possible and the marked fishes were released in another net cage kept half submerged in the same pool. The amputation of very small portions of the caudal fin caused no change in the mobility of the fish and the time lag between their release and recovery was too short for full regeneration of the cut portion. All the marked fishes were allowed to swim inside the net cage for a period of four hours. The stain lasted for a few hours and in many cases it faded off. Any fish which showed abnormality in mobility was isolated and not used in the study. All the other fishes were released in the major pool at zone C around 3 p.m. Following the above modalities fishes were captured and released on five occasions (20th, 22nd, 25th, 28th November and 2nd December 1977) in zone C and a total of 293 fishes were released. As there was no sexual dimorphism in *D. mullya,* the sex of the released fishes could not be ascertained.

To find out the possible presence of any early migrants from the lower beds (zone C) of the stream to the upper reaches (zones A & B), intensive netting was done in these latter areas at regular intervals from 7th December to 30th January 1978. Only accessible pools and rapids were searched for the marked fishes, while a few pools located in the steep (35 m) slippery part of the main stream could not be probed due to their inaccessibility. If any marked fish was caught, after measuring its length, a small mutilation was made on the inner margin of one of the pelvic fins and it was released again. This had to be done to identify the recaptured from other marked fish. Fishing was done in areas beyond zone C also to find out any possible downward movement of the marked fishes.

RESULT

The number of fishes captured with their size range and the number of them marked and released are given in the Table I. The percentage of recapture was rather low (17.06%) and this was due to the different terrain and uneven topography of the area where no standard netting device could be employed. Another difficulty faced was the inaccessibility of a few pools lying on the main stream.

DISCUSSION

Though the total percentage of recapture in migration study (17.06%) was low, it fairly reflects the mode of migration of *D. mullya* at Ulakkaruvi. From the place of recapture of marked fishes it can be inferred that these fishes ascended from Zone-C climbing along the 35 m high slippery rocky terrain to the rapids and pools present around the base of the lower falls and side stream. Thus their movement was against the current. Intensive movement of fishes were observed on 18th January 1977 at dawn among the rapids and pools of the side stream and spawning of the fishes was observed in a rapid, and eggs were collected immediately after spawning and thereafter (vide spawning). From the dates of recovery of marked fishes, observation of spawning and subsequent egg collection, it is reasonable to assume that *D. mullya* might have undertaken a prespawnal migration from the last week of December 1977 to the second week of January 1978.

TABLE I

NUMBER OF *D. mullya* RELEASED AND RECOVERED IN MIGRATION STUDIES

Length Range (mm)	Number of fishes and dates on which release was done in Zone-C 1977					Total number of fishes released in Zone C	Dates and number of fishes recovered from Zone B				Total number of fishes recovered in Zone B	Number of fishes recovered in Zone A between 25th March and 10th Apr. 1978	Total % of recovered fishes from Zones A & B
	Nov 20	Nov 22	Nov 25	Nov 28	Dec. 2		1977 Dec. 28	1978 Jan. 7	13	15			
55 — 60	11	13	7		2	33			2	1	3	2	15.15
61 — 65	2	9			6	17	2	1	4		7		41.18
66 — 70	5		40	11	30	86						4	4.65
71 — 75	18	9		27	10	64		2	6	1	9		14.06
76 — 80		20			2	22	1			4	5	8	59.09
81 — 85	16	3	8			27			1		1		3.70
86 — 90	2	6	4	3		15	1		1		2		13.33
91 — 100		7	1	13		21						5	23.81
101 — 105	3	1			4	8			3	1	4		50.00
TOTAL:	57	68	60	54	54	293	4	3	17	7	31 (10.58%)	19 (6.48%)	17.06

In the month of March 1978, the water level in most of the pools and rapids dwindled and adult fishes were scarcely seen. In order to find out whether these fishes ascend further upward, undertaking a post-spawning migration, fishing was done on several occasions (25th, 28th, 30th March and 5th, 7th and 10th April 1978), in the major pool lying at the base of the upper falls, 19 marked fishes (2 previously captured) were recovered during this intensive probing. This recapture emphasizes the fact that *D. mullya* undertakes post spawning migration when the water level in their breeding grounds goes down to a precarious level. Though water level had gone down and most of the rapids and pools were cut off without any water flow, the pools and rapids were full of larval fish in various stages of development. Several observations made by Jones (1941) may be pertinent in understanding the migration of *D. mullya.* While observing the prespawning migration of these fishes in Kallar stream of Western Ghats in Peermade Taluk, Travancore, he stated that the migration 'does not seem to have any relation to rain, as no rainfall had been recorded in this area for over 2 months'. Around Ulakkaruvi stream too there was little or no rainfall during the breeding month.

Spawning:

The first spawning at Ulakkaruvi was observed in the early hours of 18th January 1978 in a rapid, where the temperature of the water was 19°C while that of the atmosphere was 20° ± 1°C. Small shoals of *D. mullya* moved in prespawning period mostly from the main stream and pools to the rapids which hardly had a depth of 750 mm, where water flows over slowly. The bottom of the rapids was filled with an admixture of sand and mud, gravel and small boulders measuring less than 500 mm in size. The entire bottom had abundant detritus.

It was group mating, where some 15 to 20 fishes took part. Courtship behaviour involved movements such as following, chasing, and butting which appeared again and again during which extrusion of ova was clearly visible, but shedding of sperm was not observed. Eggs were shed in the water in staggering quantities and simply left to the mercy of the environment. A noteworthy feature was that the fishes were not scared by the presence of the observer.

One odd thing about *Discognathus* during spawning was that they were often found to move in groups underneath boulders. The whole process took place up to 8.30 a.m.; by that time most of the eggs were shed and their haphazard movements almost ceased. Thirteen fish were captured around 11 a.m. from the breeding rapids, out of which 8 were females and 5 males — all between 72-96 mm length range. The females were dissected in the field itself and all of them showed fully spent ovaries, thus emphasizing the fact that they had shed all the matured ova in one burst of spawning.

Eggs were highly adhesive and heavily yolked, and demersal. They adhered to the sides of the rocks and submerged decaying vegetation such as leaves and twigs; thus they were not likely to be washed down by the flowing water. When a few boulders were lifted in the evening around 4 p.m., hundreds of eggs were found to have been laid by the fishes in trough-like depressions carved out of the mud. Though 95% eggs were found to be fertilized, 5% appeared whitish (obviously unfertilized). Eggs were collected at different intervals after spawning.

On the early morning of 19th January 1978 it was surprising to find that the rapid in which spawning was observed on the previous day, no water found and the entire water had probably drained down to the neighbouring smaller crevices on the rocky terrain. This exposed the entire bottom of the rapid to the atmosphere. The whole area was however wet and the underlying mud and sand held a good amount of water, thus not allowing the bottom to dry up. When the decaying vegetation and boulders were removed, it was a pleasant surprise to find that the hundreds of eggs lying beneath them had well developed embryos, which showed normal movements. A good harvest of embryos was made. The eggs showed a high degree of adhesiveness and clumped together when held in the hand. Eggs with live embryos were taken from the rapid along with some stream water and detritus, and were brought to the laboratory. They were left inside large, well-aerated tanks to observe their further development. Unfortunately they survived for only a few hours.

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OBSERVATIONS ON THE MOVEMENT OF TWO CAPTIVE-REARED MUGGER CROCODILES, *CROCODYLUS PALUSTRIS* LESSON WHEN RETURNED TO THE WILD[1]

Lala A. K. Singh[2]

Two mugger crocodiles, at six-months age and 56.9 and 54.3 cm size escaped from captivity at GRACU into the river Mahanadi during October 1975. The maximum distance moved during the first three months after escape was 4.0 km and during the entire observation period of 18 months was 10.8 km. Growth of these mugger in the wild was similar to the ones in captivity. It is recommended that mugger when reach a size of about 55 cm can be rehabilitated in the wild for conservation purposes.

INTRODUCTION

In August 1975 the Gharial Research and Conservation Unit, Tikerpada received fifteen mugger crocodiles (*Crocodylus palustris* Lesson) from Tamil Nadu. Of these fifteen mugger, five hatchlings were collected from Hogenakal waterfall on Cauvery River in Dharmapuri district, five were collected from Kedarhali stream on Moyar River in Nilgiri district and five had hatched in captivity from eggs laid by parents collected from Mettur Dam of Salem district and captive reared in the Madras Snake Park.

Since the mugger varied in size even within the individual group, they were sorted out according to size and kept in three different pools, five per pool. Pools were 2 m × 2 m × 30 cm in size with a slope of 1.3 on one side and with one metre width sand area on all the sides for basking. Ample vegetation was provided as cover to give a feeling of security to the animals. The pools were covered by wire-mesh on the sides and roof. Adjacent pools were separated by 50 cm vertical wire-mesh partitions.

All mugger had the habit of moving, during the night, along the side of the enclosure facing the river (River Mahanadi), flowing at a distance of about 40 metres on the west. Presumably this resulted from their water orientation behaviour, as reported for gharial, *Gavialis gangeticus* (Gmelin) (Singh 1978).

On 29th October 1975, two mugger juveniles of average size from the largest group escaped by breaking through a rusted portion of the wire-mesh enclosure at a height of 15 cm above the ground. Interestingly, the side through which the mugger had escaped faced the river. This information has been published earlier (Singh 1976) but in the present paper observations relating to the detection of these mugger in the Satkoshia Gorge of Mahanadi and the subsequent movements executed by these juveniles on the next eighteen months in the wild are discussed. It is to be noted that according to a survey made earlier by Bustard (FAO 1974) and the author (unpublished data) the Satkoshia Gorge had seven wild gharial and seven wild mugger. None of the wild mugger were of sizes similar to the ones escaped from

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captivity. Furthermore, observations made by ten Gharial Guards regularly patrolling the river by boat had no report of any other mugger of this size during their observations through eighteen months.

OBSERVATIONS

Exactly one month after their escape, at about 1.5 km downstream from the Unit, a crocodilian track and a faecal pellet were detected on a rocky shore having an interspersed thick deposition of clay. Nature of the spoor, and size of the pug marks and the faecal pellet indicated that the animal that had come out to the spot for basking was a 0.5 m long mugger crocodile (Unpubl. MS.). Since the Gorge didn't have any of its recorded mugger of this size the findings suggested that perhaps both the mugger escaped out from the Unit had come into the Gorge. In confirmation to this assumption, the length of these two escaped-juveniles, taken six days before the detection of their escape, was 56.9 cm for one and 54.3 cm for the other.

A week later, two mugger were sighted at this locality both by the fishermen and the Gharial Guards. One of these juveniles moved to the opposite bank, later followed by the second one, and remained near the mouth of a stream that drains off into the river. At that time of the year (March) the spot receives a slow stream of water and it forms an ideal place to harbour a large number of fishes in small pools among half submerged rocks. Observations subsequent to these (25th December 1975 to 9th June 1977) are presented in Table 1.

TABLE 1

DATE-WISE SIGHTINGS OF THE MUGGER JUVENILES IN SATKOSHIA GORGE

Date	Location	Water level in cm (height above datum)
25.12.75	14.4*	+10.5
30.12.75	14.4	+19.0
4.1.76	14.4	+ 8.5
24.1.76	13.2	+10.5
16.2.76	17.2*	+ 7.0
27.3.76	17.2*	+ 2.0
3.4.76	16.0	+ 1.0
18.5.76	9.6	0
25.6.76	9.6	—14.0
26.7.76	9.0	+622.5
5.8.76	11.2	+640.5
16.8.76	14.0	+954.0
26.8.76	9.6	+534.5
1.9.76	9.6	+511.5
11.9.76	9.6	+425.5
14.9.76	16.0	+454.5
15.9.76	14.0	+477.5
17.9.76	16.0	+256.5
3.10.76	14.0	+60.0
14.10.76	17.6*	+47.0
27.10.76	16.0	+30.0
16.11.76	17.2*	+16.0
24.11.76	16.0	— 3.0
12.12.76	9.6	—16.0
15.12.76	9.6	—16.0
29.12.76	11.2	—26.0
3.1.77	9.6	—23.0
8.1.77	9.6	—14.0
11.1.77	11.2	— 7.0
26.1.77	16.0	—16.0
2.2.77	15.0	—14.0
9.2.77	15.0	+30.0
2.3.77	10.0	+17.0
8.3.77	11.2	+ 9.0
16.3.77	11.2	+22.0
1.4.77	11.2	+17.0
2.4.77	11.2	+12.0
19.4.77	14.4	—9.0
23.4.77	8.0	—19.0
24.4.77	9.6	—15.0
2.5.77	(10.30 a.m.) 11.2	— 2.0

Table 1 does not show the movements separately for these two juveniles; yet a close study of the data shows that after remaining near the nullah for sometime, both the juveniles moved downstream and then separated, one

2.5.77	(11.30 a.m.)	16.0	— 2.0
7.5.77		17.6	—14.0
9.5.77		6.8	—10.0
14.5.77		8.0	—17.0

Upto 9.6.77 no more sightings.

having moved upstream and the other moving further downstream. The numbers denoted in the Table for different localities refer to the distance of the place from the foot of the gorge. When the place is on the right bank, if viewed from downstream, the number is followed by an asterisk (*). The numbers in the column showing water level shows the height of the water level above the datum on the particular date at a time close to the time of sighting. During the period of observations, the highest flood was 1323 cm above the datum on 14th August 1976.

During the eighteen months observation recorded in Table 1, there were 22 sightings recorded between the places 14.0 to 17.6, and 23 sightings recorded between 6.8 and 11.2. These data clearly form two different sets of observations, apparently denoting the approximate areas occupied by the two juveniles. The location from which the juveniles had escaped was near 17.5*. The observations recorded on 11th September 1976 followed by the observation on 14th September 1976, and the observation on 7th May 1977 followed by the observation on 9th May provide further evidence to support the view that the two juveniles had occupied two different areas separated by a distance of 3-11 km. The most convincing evidence, however, is that recorded on 2nd May 1977. On that day one of the juveniles was sighted at 11.2 and the other was sighted at 16.0. The time lapse between the two observations was only an hour.

Irrespective of the fact about which particular juvenile was sighted, the number of sightings were 2 each during the months December 1975 and January 1976. From February 1976 to July 1976 there were only one sighting a month. During 1976 monsoon the sightings were more — August 3, September 5 and October 3. From November 1976 to February 1977 the sightings were 2, 3, 4 and 2 respectively. During the summer months of March 1977 to May 1977 the sightings were 3, 5 and 5 respectively.

When these mugger were last observed, they were of the size of our average captive juveniles among the largest ones of the remaining thirteen, and they had a definitely slim body when compared to the girth attained in captivity. The length and the weight of the five large juveniles among the remaining thirteen in early May 1977 are given in Table 2.

TABLE 2

LENGTH AND WEIGHT OF THE FIVE LARGE CAPTIVE MUGGER MEASURED DURING EARLY MAY 1977 (AGE 25 MONTH)

Sl. no.	Length in m	Weight in kg
1	1.40	14.6
2	1.45	16.9
3	1.54	20.9
4	1.56	20.9
5	1.16	9.8

DISCUSSION

Table 1 shows that after escape, between the period 25th December 1975 and 3rd April 1976, the maximum distance moved by the two animals was 4.0 km and during the entire eighteen months the movement was through a maximum distance of 10.8 km.

The two different localities occupied by the two juveniles are small stretches of the river, probably because the mugger, if receiving all their requirements, show very restrictive movements, as is observed in the Satkoshia Gorge fc its resident adults. To give an example, during 1975 winter an adult mugger estimated to be about 3 m long had dug a tunnel near 6.8 and in the following winter the same mugger had dug the tunnel near about 7.0* in the opposite bank.

It is noteworthy that these two escaped mugger maintained in the wild the normal growth rates (length) of their captive groups. However, as is normally the case with captive crocodilians the latter were considerably stockier than the wild ones.

Since 1975 Government of India has been offering assistance to several State Crocodile Projects in order to conserve the remaining wild populations of all three species of Indian crocodilians *Gavialis gangeticus* (Gmelin), *Crocodylus palustris* (Lesson) and *Crocodylus porosus* (Schneider). In order to restore good populations in the wild within a short period of time, grow and release techniques are carried out (Bustard in FAO 1975). This technique involves collection of wild-laid eggs, hatchery incubation, rearing the hatchlings in captivity and ultimately rehabilitating the young in suitable protected areas. Rearing of mugger is easy compared to the more delicate gharial. Moreover, mugger juveniles appear to be much more resistant to disease than gharial juveniles. Mugger, however, consume much more food than equal sized gharial (Singh 1978). This, therefore, makes it important to determine a suitable release size for mugger in order to minimise expenditure on husbandry.

When the mugger had escaped at that time the flood level was 169 cm above the datum (29th October 1975) and the animals were only six months old. Their escape was soon afterwards followed by the winter, and the highest flood (1323 cm: August 1976) came when the mugger reached an age of sixteen months. These observations suggest that mugger of about half a metre length can be released at an age of six months and will readily adapt to the changing conditions of the river. However, the main criterion should be the size of the mugger, not the age. Growth of crocodilians is greatly dependent upon food and temperature besides best husbandry conditions. Therefore, in rehabilitation programmes these factors should be maximum to achieve best growth and thus release the animals into the wild as quickly as possible thereby minimising expense and also possible changes in behaviour. It is observed that during the time of high flood the crocodilians go into the side tributaries or the backwater areas. The Satkoshia Gorge has a number of such places. For that reason it was possible for the juveniles to withstand such high flood, and this also recommends for selection of releasing sites with good zones for retreat during the flood.

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RECORDS OF MESOSTIGMATA, EREYNETIDAE AND PTERYGOSOMIDAE (ACARINA) IN WESTERN HIMALAYAS, SIKKIM AND HILL DISTRICTS OF WEST BENGAL[1]

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During a survey of haematophagous arthropods in the western Himalayas, Himalayan districts of West Bengal and Sikkim, between 1966 and 1970 a large number of Mesostigmatid, Ereynetid and Pterygosomid mites were collected. They represent 10 families, 23 genera and 54 species. Eighteen of them are new records to India and seventeen await description. They are recorded in this communication with additional notes on their ecogeographic distribution.

INTRODUCTION

Parasitic Mesostigmata, Ereynetidae and Pterygosomidae are very little known groups of ectoparasites in India. A thorough faunistic study has been still pending. The known species are very small in number, and the available information deals either with the records of small number of species come across during ectoparasitic surveys (Mehta 1937, Mitchell *et al.* 1966, Wattall *et al.* 1965, 1967a and b), description of new species (Hirst 1921, Radford 1941, 1947, 1953), or inclusion of Indian species in the faunistic reviews of the group (Strandtmann and Wharton 1958). The last authors record only 12 species from India under Mesostigmata. Allred's (1969) list of 39 species of mites infesting rodents in the northern part of Kashmir and Prasad's (1974) list of 17 species infesting rodents in Nepal throw some light on the group elsewhere in India, particularly the western and central Himalayas.

The Mesostigmatid mites infesting bats form a distinct group themselves. The literature on this group, particularly on the families Macronyssidae and Spinturnicidae deals very little with Indian species, except a monograph on bat parasites by Hiregaudar and Bal (1956), which lists only eleven species. The revisions of Macronyssidae and Laelapidae of bats by Radovsky (1967) and Spinturnicidae by Rudnick (1960) add very little to the Indian species.

The families Ereynetidae and Pterygosomidae are also very little studied in India. The 699 species of mites listed by Prasad (1974) in his Catalogue of mites of India is poorly represented by mites associated with vertebrates, particularly the mesostigmatid mites, as compared to our rich reptilian, bird and mammalian fauna.

The present communication deals with Mesostigmatid, Ereynetid and Pterygosomid mites collected as ectoparasites from Mammals, Birds and Reptiles during a haematophagous arthropod survey conducted in western Himalayan region, Sikkim and Himalayan districts of West Bengal, between 1966 and 1970, under the

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auspices of Indian Council of Medical Research (Ramachandra Rao *et al.* 1973). The collection represents 23 genera and 54 species belonging to 10 families, 18 of which are new records to India and 17 need description. Perhaps this is the largest collection of Mesostigmatid mites ever made in India. Each species is recorded here with additional notes on ecology.

Material and Methods

The material was collected as ectoparasites from small mammals, birds and reptiles. The small mammals were trapped in wire cage traps, popularly known as wonder traps and portable Sherman traps which were set up in different habitats. A few animals were also collected by shooting. The birds and bats were collected by trapping them in mist nets. Some specimens of birds were also collected by shooting. A few specimens of reptiles were collected by beating them with stick.

Each animal trapped was put inside a plastic bag and killed with chloroform vapour. The killed animal was wrapped in white lint cloth and held for four to six hours. Every animal was given a field number and entered in a field register giving details of the species, sex, date and locality of collection. The mites were combed out along with other ectoparasites and preserved in 70 per cent alcohol. Each sample was given an arthropod collection card number and entered in a specially designed card giving all the collection data. As much care was taken as possible to avoid the mixing of mites from different individual hosts or contamination at the time of brushing and preserving.

A few collections of mites were also obtained from the habitats of the hosts.

Representative specimens of each species of small mammals were skinned and the skins and skulls were preserved for confirming the identity and further reference. Bird and bat specimens were skinned and stuffed while reptiles were preserved in formalin or as dry specimens.

The mite specimens were partially cleared in 10 per cent KOH and mounted in Hoyer's medium. The mounted specimens were identified under the microscope. The small mammals were identified on the basis of classification by Ellerman & Morrison-Scott (1951) and Ellerman (1961) and the identity of the birds were determined on the basis of Fauna of British India volumes and according to Ripley (1961).

Inspite of utmost care, due to large body of collections there is every possibility of contamination while processing a large number of hosts at a time and error in determining the identity of the host specimens, particularly the juveniles.

RESULTS

A. Systematic list of mites collected

Order ACARINA
Suborder MESOSTIGMATA Canestrini, 1891
Cohort GAMASINA Leach, 1815
Family LAELAPIDAE Berlese, 1892
Genus *Androlaelaps* Berlese, 1903
1. *Androlaelaps aduncus* Allred, 1969
2. *Androlaelaps casalis* (Berlese, 1887)
3. *Androlaelaps marshalli* Berlese, 1911
4. *Androlaelaps zuluensis* (Zumpt, 1950)
5. *Androlaelaps* sp.

Genus *Hypoaspis* Canestrini, 1884
6. *Hypoaspis pavlovskii* (Bregetova, 1955)
7. *Hypoaspis miles* (Berlese, 1892)

Genus *Laelaps* Koch, 1836
8. *Laelaps agilis* Koch, 1836
9. *Laelaps algericus* Hirst, 1925
10. *Laelaps buxtoni* Radford, 1941
11. *Laelaps jugalis* Allred, 1969
12. *Laelaps nuttalli* Hirst, 1916
13. *Laelaps traubi* Domrow, 1962
14. *Laelaps turkestanicus* Lange, 1955

15. *Laelaps* sp. 1
16. *Laelaps* sp. 2
17. *Laelaps* sp. 3
Genus *Echinolaelaps* Ewing, 1929
18. *Echinolaelaps echidninus* Berlese, 1887
Family MACRONYSSIDAE Oudemans, 1936
Genus *Macronyssus* Kolenati, 1858
19. *Macronyssus kumaonicus* Bhat, 1973
Genus *Ornithonyssus* Sambon, 1928
20. *Ornithonyssus bacoti* (Hirst, 1913)
21. *Ornithonyssus bursa* (Berlese, 1888)
22. *Ornithonyssus sylviarum* (Canestrini and Fanzago, 1877)
23. *Ornithonyssus* sp.
Genus *Sauronyssus* Sambon, 1928
24. *Sauronyssus* sp.
Genus *Hirstionyssus* Fonseca, 1948
25. *Hirstionyssus musculi* (Johnston, 1849)
Genus *Steatonyssus* Kolenati, 1858
26. *Steatonyssus javensis javensis* Oudemans, 1914.
27. *Steatonyssus* sp. 1
28. *Steatonyssus* sp. 2
29. *Steatonyssus* sp. 3
Genus *Pellonyssus* Clark and Yunker, 1956
30. *Pellonyssus passeri* Yunker, 1956
31. *Pellonyssus* sp.
Family DERMANYSSIDAE Kolenati, 1859
Genus *Liponyssoides* Hirst, 1913
32. *Liponyssoides muris* (Hirst, 1913)
33. *Liponyssoides sanguineus* (Hirst, 1914)
Genus *Dermanyssus* Duges, 1834
34. *Dermanyssus gallinae* (DeGeer 1778)
35. *Dermanyssus* sp.
Family MYONYSSIDAE Strandtman and Wharton, 1958
Genus *Myonyssus* Tiraboschi, 1904
36. *Myonyssus* sp.
Family HAEMOGAMASIDAE Oudemans, 1926
Genus *Eulaelaps* Berlese, 1903
37. *Eulaelaps indiscretus* Allred, 1969
38. *Eulaelaps stabularis* (Koch, 1836)
Genus *Haemogamasus* Berlese, 1889
39. *Haemogamasus nidiformis* Bregetova, 1955
40. *Haemogamasus gyrinodes* Allred, 1969
Family RHINONYSSIDAE Trouessart, 1895
Genus *Tinaminyssus* Strandtmann and Wharton, 1958
41. *Tinaminyssus* sp.
Family SPINTURNICIDAE Oudemans, 1901
Genus *Spinturnix* von Heyden, 1826
42. *Spinturnix pindarensis* Bhat, 1973
43. *Spinturnix plecotinus* (C. L. Koch, 1839)
44. *Spinturnix* sp.
Genus *Paraperiglischrus* Rudnick, 1960
45. *Paraperiglischrus rhinolophinus* (C. L. Koch, 1841)
46. *Paraperiglischrus* sp.
Genus *Ancystropus* Kolenati, 1856
47. *Ancystropus eonycteris* Delfinado and Baker, 1963
48. *Ancystropus kanheri* Hiregaudar and Bal, 1956
49. *Ancystropus taprobanicus* (Turk, 1950)
50. *Ancystropus zeleborii* Kolenati, 1856
Genus *Meristaspis* Kolenati, 1857
51. *Meristaspis lateralis* (Kolenati, 1856)
Family MACROCHELIDAE Vitzthum, 1930
Genus *Nothroholaspis* Berlese, 1903
52. *Northroholaspis* sp.
Suborder TROMBIDIFORMES Reuter, 1909
Family EREYNETIDAE Oudemans, 1931
Genus *Boydaia* Womersley, 1953
53. *Boydaia* sp.
Family PTERYGOSOMIDAE Oudemans, 1910
Genus *Pterygosoma* Peters, 1849
54. *Pterygosoma* sp.

B. RECORDS AND NOTES

The detailed host and locality records for each species together with taxonomic and general ecological notes are given below in a systematic sequence. The altitudes given are approximate.

1. **Androlaelaps aduncus**

Described and recorded from *Tatera indica* from several localities in Pakistan (Allred 1969).

Present records:

Host and Habitat	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	1	1♀
Tatera indica	1	1♂, 1♀, 1N
Mus platythrix	1	6♂, 6♀, 1N
Suncus murinus	1	1♀
Rodent burrow	1	2♀

LOCALITIES: *Himachal Pradesh*: *Kangra*: Nurpur (580 m) *Uttar Pradesh*: *Naini Tal*: Garjia (450 m); *Pauri*: *Dalmisain* (900 m); Dehra Dun: Ramgarh (620 m). Sikkim: Shyari at Gangtok (1350 m).

Notes: These are the first records of this species from India.

The generic differentiation of *Androlaelaps* Berlese, 1903, *Haemolaelaps* Berlese, 1910 and *Hypoaspis* Canestrini, 1884 is still under controversy (Allred 1970). In this communication the genera and species of *Androlaelaps* and *Hypoaspis* are sorted out on the basis of the keys provided by Allred (1969).

2. **Androlaelaps casalis**

Cosmopolitan, recorded from a wide variety of birds and mammals and from straw, hay, and detritus (Strandtmann and Wharton 1958). Earlier the species was recorded from *Mus musculus* at Kanha National Park, Madhya Pradesh (Mitchell *et al.* 1966).

Present records:

Host	No. of coll.	Specimens coll.
Mus musculus	2	2♀
Suncus murinus	3	5♀

LOCALITIES: *Jammu & Kashmir*: *Baramulla*: Sopore (1630 m); Dehari (750 m); *Rajouri*: Naushera (750 m). *Himachal Pradesh*: *Mahasu*: Bhadras (1300 m). *Sikkim*: Shyari at Gangtok.

Notes: First record from *Suncus murinus.*

3. **Androlaelaps marshalli**

Recorded earlier from Pakistan (Allred 1969).

Present records:

Host and Habitat	No. of coll.	Specimens coll.
Mus platythrix	1	7♀
Tatera indica	3	9♀
Rodent burrow	1	1♀

LOCALITIES: *Jammu & Kashmir*: *Rajauri*: Naushera. *Himachal Pradesh*: *Kangra*: Nurpur. *Uttar Pradesh*: *Dehra Dun*: Ramgarh; *Tehri*: Munikireti (450 m).

Notes: First record from India.

4. **Androlaelaps zuluensis**

Recorded earlier from Pakistan (Allred 1969).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattus	1	1♀
Mus platythrix	1	1♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Udhampur (750 m). *Uttar Pradesh*: *Tehri*: Ghonti (900 m).

Notes: First record from India.

5. **Androlaelaps** sp.

Apparently a new species related to *Androlaelaps casalis*.

Records:

Host and Habitat	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	26	5♂, 48♀, 5N
Rattus rattus brunneusculus	2	4♀
Rattus nitidus	1	1♀
Rattus rattoides	2	2♀
Rattus fulvescens	1	1N
Rattus sp.	3	6♂, 3♀
Rattus (*Millardia*) *meltada*	1	2♀, 1N
Mus platythrix	1	1♀
Mus musculus	6	7♀, 1N
Mus sp.	2	2♀
Suncus murinus	10	12♀
Rodent burrow	1	2♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Dehari; *Doda*: Bhadarwah (1800 m); *Rajauri*: Naushera. *Himachal Pradesh*: *Kulu*: Bhuin (1100 m), Hurla (1000 m), Larji (1000 m); *Mahasu*: *Dukolad* (1000 m); *Bilaspur*: Deoli (510 m); *Kangra*: *Baijnath* (1350 m), Nurpur; *Chamba*: Krain (900 m), Chamba. *Uttar Pradesh*: *Naini Tal*: Bilaspur at Bhim Tal (1450 m), Dugada (750 m), Haldwani (420 m), Basutia (750 m), Garjia, Ranibag (700 m); *Almora*: Sukhidhang (1400 m), Chalthi (750 m); *Pithoragarh*: Aat (950 m); *Chamoli*: Bagrigad (1850 m), Didoli (900 m); *Dehra Dun*: Ramgarh, Sahasradhara (900 m): *Tehri*: Munikireti; *Uttarkashi*: Sukrala (1400 m). *West Bengal*: *Darjeeling*: Tashiding (450 m); *Jalpaiguri*: Chunabhatti (180 m). *Sikkim*: Shyari at Gangtok.

Notes: The species comes close to *Androlaelaps casalis* (Berlese, 1887), but differs by having metapodal plate less than two times as long as wide; which in *A. casalis* is three times as long as wide.

6. **Hypoaspis pavlovskii**

Recorded earlier from Pakistan (Allred 1969).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	7	7 ♀
Rattus rattoides	3	3 ♀
Rattus sp.	2	3 ♀
Apodemus flavicollis	5	8 ♀
Mus musculus	1	1 ♀
Suncus murinus	1	1 ♀

LOCALITIES: *Jammu & Kashmir*: *Doda*: Khilani (1400 m). *Himachal Pradesh*: *Lahul & Spiti*: Keylong (3250 m); *Kulu*: Bhuin; *Kangra*: Baijnath; *Kinnaur*: Sangla (2700 m), Rakcham (3120 m), Chitkul (3400 m). *Uttar Pradesh*: *Naini Tal*: Mukteshwar (2150 m), Latoli (1800 m), Dugada; *Almora*: Kalika at Ranikhet (1800 m); *Chamoli*: Gwaldam (1900 m); *Dehra Dun*: Asarodi (700 m), Mussoorie (2000 m); Uttarkashi (1000 m).

Notes: First records from India.

7. **Hypoaspis miles**

Recorded earlier from Pakistan (Allred 1969).

Present records:

Host	No. of coll.	Specimens coll.
Mus musculus	3	2 ♀, 1N
Suncus murinus	1	3 ♀, 2N
Herpestes edwardsi	1	1 ♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Phalata (710 m), Dehari; *Rajauri*: Naushera. *Himachal Pradesh*: *Mahasu*: Pipty at Rampur (1100 m), Ratanadi at Baghi (2700 m).

Notes: First records from India.

8. **Laelaps agilis**

The species is known to be distributed in Europe and USSR on *Apodemus, Clethrionomys* and *Talpa* (Strandtmann and Wharton 1958). Also recorded from Turkey on *Apodemus, Cricetulus* and *Mus* (Garret and Allred 1971).

Present records:

Host	No. of coll.	Specimens coll.
Apodemus flavicollis	126	183 ♂, 1045 ♀, 88N
Mus musculus	4	2 ♂, 30 ♀, 3N
Rattus rattoides	2	5 ♀
Alticola roylei	2	3 ♀
Crocidura sp.	2	3 ♀

LOCALITIES: *Jammu & Kashmir*: *Ladakh*: Kargil (2700 m), Drass (3200 m), Fraw (3200 m), Baru (3200 m), Leh (3500 m). *Baramulla*: *Chektreran* (2250 m), Chetternar (2000 m); *Srinagar*: Sonamarg (2750 m); *Anantnag*: Pehalgam (2450 m). *Himachal Pradesh*: *Chamba*: Kalatop (2450 m), Surkhigalli (1650 m), Thirot (3150 m), Tindi (2500 m); *Lahul & Spiti*: Kelong, Sissu (3120 m), Yongkirting (2800 m); *Kulu*: Kothi (2460 m); *Kinnaur*: Kalpa (2750 m), Sangla, Rakcham, Chitkul; *Mahasu*: Ratanadi at Baghi. *Uttar Pradesh*: *Pithoragarh*: Milam (3540 m), Relkote (3000 m); *Chamoli*: Badrinath (3170 m); *Uttarkashi*: Harsil (2600 m), Choolmie (2750 m).

Notes: Allred (1969) recorded *Laelaps pavlovskyi* Zachvatkin, 1948 from Pakistan. His further comparative studies of *L. pavlovskyi* and *L. agilis* from Turkey led him to the presumption that the two species are synonymous, and represent only intra-specific variant as is typical with several other species of *Laelaps* (Garrett and Allred 1971). The senior author of the present paper has examined USSR specimens of both the species, *L. agilis* from *Apodemus flavicollis* and *L. pavlovskyi* from *A. agrarius.* The species appear to be quite distinct and associated with *A. flavicollis* and *A. agrarius* respectively. The specimen of *L. pavlovskyi* differs from those of *L. agilis* mainly by having the posterior setal pairs on genitoventral plate wide apart, in addition to other specific characters.

In the Himalayas the species has been collected only in the upper temperate and alpine zones, the ecogeographical limit of the distribution of *Apodemus flavicollis.* This is the first record of this mite from India.

9. **Laelaps algericus**

The species has been recorded from Algeria, Egypt, Israel, Turkey, Pakistan, USSR; from mammals of 13 genera (Strandtmann and Wharton 1958, Garrett and Allred 1971). In India it has been recorded from *Mus booduga* and *Mus musculus* (Mitchell *et al.* 1966).

Present records:

Host	No. of coll.	Specimens coll.
Mus musculus	274	19♂,1234♀,30N
Mus sp.	9	24♀
Apodemus flavicollis	1	8♀
Alticola roylei	1	6♀
Rattus rattus gangutrianus	2	2♀
Rattus rattoides	3	3♀
Rattus rattus rufescens	5	6♀
Rattus sp.	10	1♂,18♀
Suncus murinus	2	3♀

LOCALITIES: *Jammu & Kashmir*: *Ladakh*: Kargil, Baru; *Shrinagar*: Sonamarg; *Anantnag*: Pehalgam, Mondilan (3200 m); *Baramulla*: Ferozpur (2460 m), Chektreran, Sopore, Bandipore (1850 m), Chetternar, Erin (2000 m), Marder (2000 m), Rampore (1400 m); *Doda*: Bhadarwah, Khilani; *Udhampur*: Phalata. *Himachal Pradesh*: *Chamba*: Salooni (1770 m), Rakh (1070 m), Schuin at Bharmaur (2300 m), Bharmaur (2300 m), Gothalhu at Bharmaur (2150 m), Durgathi (1500 m), Tissa (1570 m), Dikrund at Tissa (1700 m); *Lahul & Spiti*: Morang (3820 m); *Kangra*: Dadh (1080 m), Bagsunag (1900 m); *Kulu*: Bharie at Kulu (1400 m), Bhuin, Gutkar (710 m), Sooma (1400 m), Palchan (2350 m), Kothi at Mandi, Hurla, Kasol (1550 m), Naggar (1550 m), Jibi (1900 m), Khundan (1420 m), Larji, Manali (1824 m), Vaishista (1820 m); *Mahasu*: Pipty, Rachauli (1450 m), Dukolad, Nirith (990 m), Khaneri (1300 m), Sarhan (2500 m), Manjagaon (2150 m), Gangtoli & Kapoori at Rohru (1600 m), Samoli (1700 m) & Somala

(1600 m) at Rohru, Kotkhai (1800 m), Chhoi (1700 m), Darhar at Kothaki (1800 m), Gumma (1700 m), Jugatkhana (1200 m), Bhadras, Jeori (1400 m), Gaura, Ratanadi at Baghi, Bhagi (2740 m), Sungri (2650 m); *Kinnaur*: Jeorit, Karcham (1800 m). *Uttar Pradesh*: *Naini Tal*: Bhim Tal (1380 m); *Almora*: Sukhidhang, Silagadi (1400 m); Khati (2350 m); *Pithoragarh*: Kotera at Dharchula (1050 m); *Chamoli*: Gwaldam, Radki (750 m), Sunyala (1050 m), Badrinath, Joshimath (2000 m), Sonla (900 m); *Tehri*: Ghansali (1050 m); *Uttarkashi*: Sukhi (2650 m), Choolmie (2700 m), Kuthnaur (1600 m), Sukrala. *Sikkim*: Lachung (2750 m).

10. **Laelaps buxtoni**

Originally described on specimens collected from "a gerbille", probably *Tatera indica*, at Madras (Radford 1941).
Present record:

Host	No. of coll.	Specimens coll.
Tatera indica	1	1 ♀

LOCALITY: *Uttar Pradesh*: *Naini Tal*: Garjia.

Notes: The species appears to be rare. A dozen specimens of *Tatera indica* collected in Jammu & Kashmir and Himachal Pradesh were found negative for this mite. The record appears to be the first, subsequent to its description by Radford.

11. **Laelaps jugalis**

Described on the basis of specimens collected from *Rattus rattus*, *Nesokia indica* and *Tatera indica* in Pakistan (Allred 1969).
Present records:

Host	No. of coll.	Specimens coll.
Rattus (*Millardia*) *meltada*	11	1 ♂, 193 ♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Dehari; *Rajauri*: Naushera. *Himachal Pradesh*: *Kangra*: Nurpur; *Mandi*: Gutkar.

Notes: First record from India and on *Rattus* (*Millardia*) *meltada*.

12. **Laelaps nuttalli**

Originally described on specimens collected from *R. rattus* and *R. norvegicus* in Ceylon, by Hirst. Subsequently it has been recorded from several genera and species of rodents. The preferred hosts of this mite are species of the genus *Rattus*. The mite is found throughout tropical and warm temperate zones wherever its host is found, with the apparent exception of Europe (Strandtmann and Wharton 1958).
Present records:

Host	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	57	2 ♂, 237 ♀
Rattus rattus brunneusculus	2	1 ♂, 37 ♀
Rattus rattus	10	1 ♂, 53 ♀
Rattus nitidus	1	3 ♀
Rattus rattoides	1	3 ♀
Rattus (*Millardia*) *meltada*	8	4 ♂, 24 ♀, 1N
Mus platythrix	1	1 ♀
Mus sp.	1	9 ♀
Suscus murinus	2	4 ♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Dehari; *Rajauri*: Naushera. *Himachal Pradesh*: *Mandi*: Gutkar; *Kangra*: Dadh, Nurpur, Baghany (600 m); *Kulu*: Palcham; *Bilaspur*: Deoli, Ghumarwin (740 m); *Mahasu*: Baghi. *Uttar Pradesh*: *Naini Tal*: Bhim Tal, Dugada, Basutia, Dwan (250 m), Garjia, Ranibag (650 m); *Almora*: Chalthi; *Pithoragarh*: Dharchula (1050 m); *Pauri*: Raitoli (770 m), Shrinagar (560 m), Dugadda (700 m), Dalmisain, Hanumanti (770 m); *Chamoli*: Radki, Sunyala, Didoli at Sonla; *Dehra Dun*: Ramgarh, Barkote (450 m), Satyanarayan (370 m), Asarodi; *Tehri*: Ghansali; *Uttarkashi*: Sukrala.

Notes: From the record this species appears to be distributed in the tropical and subtropical zone only.

13. **Laelaps traubi**

This species was described on the basis of specimens collected from *Rattus fulvescens, R. edwardsi, Rattus* sp. and *Dremomys rufigenis* from Gunong Brinchang, Camerol Highlands, Malaya by Domrow (1962). Recently the species was recorded from *R. nitidus, R. eha, R. fulvescens* and *Rattus* sp. in Nepal (Prasad 1974).

Present records:

Host	No. of coll.	Specimens coll.
Rattus fulvescens	24	11♂, 314♀, 2N
Rattus niviventer	10	58♀
Rattus eha	2	11♀
Rattus rattoides	3	7♀
Rattus sp.	1	1♀
Suncus murinus	1	1♀

LOCALITIES: *Himachal Pradesh*: *Kangra*: Dadh; *Kulu*: Jibi, Rashala (1900 m); *Sirmaur*: Moginand (500 m). *Uttar Pradesh*: *Naini Tal*: Mukteshwar; *Almora*: Khati, Dwali (2750 m); *Pithoragarh*: Munshiari (2300 m); *Chamoli*: Gwaldam, Sunilgaon at Joshimath (2300 m), Bagrigad (1800 m); *Uttarkashi*: Kuthnaur. *West Bengal*: *Darjeeling*: Kurseong (1400 m), Jorepokhri (2350 m). *Sikkim*: Chungtang (1850 m).

Notes: This is the first record from India. The species appears to be associated with the subgenus *Myxomys* of the genus *Rattus*. The record from *Rattus rattoides* is probably due to its overlapping distribution with the species of *Myxomys*, because the specimens of *R. rattoides* collected from other localities where this subgenus was not found did not yield this species.

14. **Laelaps turkestanicus**

Original description and record is based on specimens from *Rattus turkestanicus* in Tadzhikistan, USSR. Allred (1969) recorded it in Pakistan and Prasad (1974) in Nepal.

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattoides	61	4♂, 554♀
Rattus fulvescens	17	3♂, 252♀, 4N
Rattus niviventer	6	27♀
Rattus eha	1	1♀
Rattus rattus gangutrianus	4	22♀
Rattus rattus rufescens	1	1♀
Rattus sp.	14	7♂, 138♀
Mus musculus	1	2♀

LOCALITIES: *Jammu & Kashmir*: *Baramulla*: Rampore; *Doda*: Bhadarwah. *Himachal Pradesh*: *Chamba*: Banikhet (1700 m), Surkhigalli, Kalatop; *Kulu*: Kothi at Manali, Palcham, Jibi, Vaishista at Manali; *Simla*: Simla (2000 m); *Mahasu*: Sarhan, Chool, Guara, Dobhdha (2000 m), Baghi, Sungri (2650 m); *Kinnaur*: Kalpa, Sangla, Rakcham. *Uttar Pradesh*: *Naini Tal*: Mukteshwar, Latoli; *Almora*: Khati, Dwali; *Pithoragarh*: Kuity (1250 m), Munshiari; *Chamoli*: Gwaldam, Sunilgaon, Bagrigad, Pangarpoora (2450 m), Dogalbita (2350 m); *Dehra Dun*: Mussoorie, Polu at Mussoorie (1800 m); *Tehri*: Chirbatia (2450 m); *Uttarkashi*: Sukhi, Kuthnaur, Sukrala. *West Bengal*: *Darjeeling*: Jorepokhri.

Notes: This is the first record from India.

The species appears to be primarily associated with *Rattus rattoides* and secondarily adapted to the subgenus *Myxomys* wherever there is geographical overlapping between *rattoides* and *Myxomys* in the Himalayan temperate zone. Records from other host species appear to be spurious.

15. **Laelaps** sp. 1

Records:

Host	No. of coll.	Specimens coll.
Mus platythrix	13	51 ♀, 2N

LOCALITIES: *Himachal Pradesh*: *Kangra*: Dharamashala (1250 m). Baijnath; *Simla*: Malkumajara (500 m); *Sirmaur*: Beradwala at Nahan (520 m), Moginand (500 m). *Uttar Pradesh*: *Almora*: Silagadi; *Pauri*: Narkota (750 m); *Chamoli*: Radki at Karnprayag; *Tehri*: Munikireti, Ghonti.

Notes: The species closely resembles *L. algericus* by heavily chitinized thickened anterolateral margin of the dorsal plate, but the specimens are much larger. The larger size and the association with *Mus platythrix* distinguishes this species. The species awaits description.

16. **Laelaps** sp. 2

Records:

Host	No. of coll.	Specimens coll.
Golunda ellioti	6	3 ♂, 13 ♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Dehari; *Rajauri*: Naushera. *Himachal Pradesh*: *Mandi*: Gutkar. *Uttar Pradesh*: *Pauri*: Raitoli; *Chamoli*: Radki.

Notes: Somewhat resembles *L. nuttalli*, but differs from it by having slender and longer coxal spurs. A distinct species, apparently associated with *Golunda ellioti*. The species is awaiting description.

17. **Laelaps** sp. 3

Records:

Host	No. of coll.	Specimens coll.
Golunda ellioti	10	1 ♂, 56 ♀

LOCALITIES: *Jammu & Kashmir*: *Udhampur*: Dehari; *Rajauri*: Naushera. *Himachal Pradesh*: Mandi: Gutkar. *Uttar Pradesh*: *Chamoli*: Radki.

Notes: This is a distinct species awaiting description.

18. **Echinolaeps echidninus**
(= *Laelaps echidnina*)

A cosmopolitan species found on commensal *Rattus* (*Rattus*) spp., but occasionally found on non-commensal species. It is not known to bite man and is never found on birds. The records from mammals other than *Rattus* probably represent accidental associations (Mitchell *et al.* 1966, Strandtmann and Wharton 1958).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	202	10 ♂, 1769 ♀, 1N
Rattus nitidus	12	82 ♀
Rattus rattoides	1	1 ♀
Rattus fulvescens	6	202 ♀
Rattus rattus	5	79 ♀
Rattus sp.	26	6 ♂, 279 ♀
Rattus rattus brunneusculus	4	9 ♀
Tatera indica	2	2 ♀
Mus musculus	2	1 ♂, 3 ♀
Suncus murinus	6	9 ♀

LOCALITIES: *Jammu & Kashmir*: Udhampur: Phalata, Dehari; *Rajauri*: Naushera; *Doda*:

Khilani. *Himachal Pradesh*: *Kulu*: Jibi; *Kangra*: Dadh, Dharamshala, Nurpur, Baghany, Dugadda at Hamirpur (900 m); *Mandi*: Mandi (1050 m); *Mahasu*: Jagatkhana; *Bilaspur*: Ballu at Ghumarwin. *Uttar Pradesh*: *Naini Tal*: Bhim Tal, Sat Tal (1400 m), Dugada, Basutia, Dogaon, Nandpur (400 m), Dwan, Garjia, Bilaspur (1400 m), Bhowali (1650 m), Ranibag; *Almora*: Sukhidhang, Chalthi, Silagadi, Loharkhet (1750 m), Bageshwar (750 m); *Pithoragarh*: Tadigaon (1550 m), Dharchula, Aat at Gocher, Kuity, Tejam (950 m), Lilam (2000 m), Gocher (950 m), Pithoragarh (1800 m); *Pauri*: Narkota, Raitoli, Gugadda, Dalmisain, Hanumanti; *Chamoli*: Galdam, Radki, Sunyala, Guliyo (1050 m), Debal (1350 m), Bagrigad, Didoli, Sonla, Nandprayag (900 m), Phata (1700 m); *Dehra Dun*: Dehra Dun (600 m), Ramgarh, Sahasradhara, Asarodi (620 m); *Tehri*: Munikireti, Ghansali; *Uttarkashi*: Basunga (1050 m), Uttarkashi, Jnanasu (1050 m), Kathnaur, Sukrala. *West Bengal*: *Darjeeling*: Tashiding; *Jalpaiguri*: Chunabhatti (170 m).

Notes: As many as 93 specimens of this mite were collected from one individual of *Rattus rattus gangutrianus* and 115 specimens from a *Rattus fulvescens.*

19. **Macronyssus kumaonicus**

The species is new to science and was described in a separate paper (Bhat 1973a).

20. **Ornithonyssus bacoti**

A cosmopolitan mite associated with rodents, particularly Muridae (Strandtmann and Wharton 1958).

Present records:

Host and Habitat	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	14	7♂, 12♀, 47N
Rattus nitidus	4	4♀, 1N
Rattus rattoides	9	9♀, 23N
Rattus sp.	7	8♀, 17N
Rattus niviventer	1	1N
Rattus rattus rufescens	5	3♂, 1♀, 4N
Bandicota bengalensis	1	4N
Alticola roylei	1	1N
Mus musculus	11	1♂, 8♀, 11N
Mus platythrix	1	1N
Suncus murinus	3	3♀, 1N
Chicken coops	1	1♂, 50♀, 1N

LOCALITIES: *Jammu & Kashmir*: *Ladakh*: Kargil; *Baramulla*: Marder, Rampore. *Himachal Pradesh*: *Chamba*: Salooni, Dikrund at Tissa, Shekari (1540 m); *Kangra*: Baghany, Lad (900 m), Dugadda (900 m), Jintnu (1000 m); *Kulu*: Naggar, Rashala, Palchan; *Mandi*: Gutkar, Jogindernagar (1250 m); *Mahasu*: Sirhan Samala at Rohru (1600 m), Jagatkhana; *Bilaspur*: Ballu at Ghumarwin, Bakrol (800 m); *Sirmaur*: Moginand (500 m). *Uttar Pradesh*: *Naini Tal*: Dugada, Mukteshwar; *Almora*: Kalika; *Pithoragarh*: Aat, Milam; *Chamoli*: Sinhdhara at Joshimath (1800 m), Dogilbita, Baniakund (2500 m), Gwaldam; *Dehra Dun*: Satyanarayan; *Tehri*: Ghansali; *Uttarkashi*: Uttarkashi, Jnanasu, Sukhi, Kuthnaur, Sukrala.

21. **Ornithonyssus bursa**

The species has been commonly known as tropical fowl mite and is tropicopolitan in distribution. Commonly found on birds and rarely on mammals in peridomestic surroundings (Strandtmann and Wharton 1958).

Present records:

Host and Habitat	No. of coll.	Specimens coll.
Chicken coops	1	3 ♀
Psittacula himalayana	2	4 ♀
Rattus rattoides	1	2 ♀
Rattus rattus gangutrianus	1	1 ♀
Rattus sp.	1	1 ♀
Dendrocitta himalayana	1	2 ♀
Aegithalos concinna	1	1 ♀
Zoothera sp.	1	1 ♂, 1 ♀

Localities: *Jammu & Kashmir*: *Baramulla*: Marder. *Himachal Pradesh*: *Chamba*: Kalatop; *Mindi*: Gutkar; *Kulu*: Bhuin; *Kangra;* Dugadda, Hamirpur, Lad. *Uttar Pradesh*: *Chamoli*: Dogalbita, Baniakund.

22. **Ornithonyssus sylviarum**

The species has been known in the temperate regions of all the continents on mammals and birds (Strandtmann and Wharton 1958).

Present records:

Host	No. of coll.	Specimens coll.
Pycnonotus leucogenys	1	2 ♀
Rattus nitidus	1	2 ♀

Localities: *Himachal Pradesh*: *Mandi*: Mandi. *Uttar Pradesh*: *Uttarkashi*: Jnanasu.

Notes: This is the first record of this species from India and appears to be rare in Indian area.

23. **Ornithonyssus** sp.

The identity of 2 ♀ and 1N collected from *Herpestes auropunctatus* at Bandipore, Baramulla district, Jammu & Kashmir on 2 Nov. 1969 has yet to be determined. The specimens come close to *O. bursa* but differ from it by the broader scutum.

24. **Sauronyssus** sp.

Records:

Host	No. of coll.	Specimens coll.
Agama tuberculata	23	28 ♂, 4 ♀, 57N

Localities: *Himachal Pradesh*: *Kinnaur*: Wangtu (2040 m), Pooh (2700 m); *Kulu*: Naggar; *Mahasu*: Pipty. *Uttar Pradesh*: *Pithoragarh*: Lilam, Thalkedar (2600 m), Bogdyar (2850 m), Khela (1400 m); *Chamoli*: Loharjungdhar (2400 m).

Notes: Very little information has been available on the acarines of Indian reptiles. This is a virgin field for acarologists.

25. **Hirstionyssus musculi**

The species has been known from Rodent genera *Apodemus, Clethrionomys, Microtus, Micromys* and *Rattus* in Europe and Asia (Strandtmann and Wharton 1958).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattoides	11	7 ♂, 48 ♀, 17N
Apodemus flavicollis	57	10 ♂, 211 ♀, 28N
Mus musculus	23	4 ♂, 34 ♀, 4N
Alticola roylei	10	18 ♀, 12N

Localities: *Jammu & Kashmir*: *Ladakh*: Kargil, Honaki (2800 m), Bodhkharbu (3250 m), Dumgal (2500 m), Drass, Fraw, Baru (Kargil); *Anantnag*: Mondilan (2250 m), Pehalgam; *Baramulla*: Chektreran near Tangmarg, Rampore. *Himachal Pradesh*: Chamba: Sindwadi, Tindi; *Lahul & Spiti*: Keylong, Chhetru (3450 m), Thirot, Yongkirting (2700 m); *Kulu*: Palchan; *Mahasu*: Jeorit, Baghi; *Kinnaur*: Kalpa, Sangla, Rakcham, Chitkul. *Uttar Pradesh*: Pithoragarh: Relkote, Munshiari, Milam; *Chamoli*: Badrinath.

Notes: The specimens were compared with identified material from Russia and were found identical with them. This is the first record of this species from India.

26. **Steatonyssus javensis javensis**

The species was earlier recorded from Maharashtra (Prasad 1974) and Pakistan (Allred 1969).

Present record:

Host	No. of coll.	Specimens coll.
Pipistrellus sp.	1	1♀, 2N

Locality: *Jammu & Kashmir*: *Udhampur*: Phalata.

27. **Steatonyssus** sp. 1

A total number of 11 nymphs were collected from the following species of Chiropteran hosts. The specific identity of the specimens could not be determined due to the lack of adequate associated adult material and the inadequacy of the literature on the immature stages.

Records:

Host	No. of coll.	Specimens coll.
Rhinolophus pearsoni	1	3N
Scotophilus healthi	2	1♀, 6N
Pipistrellus mimus	2	2N

Localities: *Uttar Pradesh*: *Naini Tal*: Haldwani, Ramnagar; *Pauri*: Narkota. *Himachal Pradesh*: *Simla*: Malkumajara.

28. **Steatonyssus** sp. 2

Present record:

Host	No. of coll.	Specimens coll.
Mus platythrix	1	1♀

Locality: *Jammu & Kashmir*: *Udhampur*: Phalata.

Notes: The species could not be placed under any known species. Apparently this is a new taxon.

29. **Steatonyssus** sp. 3

Present record:

Host	No. of coll.	Specimens coll.
Pipistrellus babu	1	4♂, 3♀, 7N

Locality: *Uttar Pradesh*: *Almora*: Sukhidhang.

Notes: The species closely resembles *S. javensis javensis* (Oudemans, 1914), but differs from it by having divided peritremal plate. The earlier record of *S. javensis javensis* from *Pipistrellus babu* needs confirmation.

30. **Pellonyssus passeri**

The species was first described from *Passer domesticus* in United States (Clark and Yunker 1956).

Present records:

Host	No. of coll.	Specimens coll.
Passer domesticus	3	1♂, 17♀, 26N
Pycnonotus leucogenys	1	2♀
Cuculus canorus	1	1♂, 2♀

Localities: *Jammu & Kashmir*: *Ladakh*: Pratapgunj (2750 m) near Kargil. *Himachal Pradesh*: *Mandi*: Mandi. *Uttar Pradesh*: *Uttarkashi*: Kuthnaur, Sukrala.

Notes: The senior author of this communicaton has examined specimens from *Ploceus philippinus* (Weaver bird) collected around Poona and specimens of *Pellonyssus passeri* collected from *Passer domesticus* at College Park, Md., U.S.A. All these specimens including the present collections are identical and they conform with the description of *Pellonyssus passeri.* This is the first record of this species from India.

31. **Pellonyssus** sp.

1 ♀ and 1N, collected from a Munia (*Lonchura* sp.), Phalata, Udhampur, Jammu & Kashmir, 27 Nov. 69.

Notes: The species closely resembles *P. viator* (Hirst, 1921) in many respects; but differs from it by having proportionately longer anterior sternal setae, which are approximately three times longer than the length of the sternal plate. The anterior pair of sternal setae in *P. viator* is as long or slightly longer than the length of sternal plate.

32. **Liponyssoides muris**

The species has been recorded from Africa and Asia ex rodents (Strandtmann and Wharton 1958).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	3	1♂, 4♀, 2N
Suncus murinus	3	3♀
Passer rutilans	1	1♀

LOCALITIES: *Jammu & Kashmir*: *Doda*: Bhadarwah. *Uttar Pradesh*: *Naini Tal*: Navkuchia Tal, Dugada; *Pithoragarh*: Aat, Kuity; *Dehra Dun*: Satyanarayan.

Notes: The authors have examined several other populations of this species. The species obviously differs from *Liponyssoides* (= *Allodermanyssus*) *sanguineus* and has a distinct identity.

33. **Liponyssoides sanguineus**

A very common parasite of rodents with a wide geographic range including North Africa, Asia and North America (Strandtmann and Wharton 1958). Recently it was recorded from Pakistan (Allred 1969).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattus gangutrianus	14	8♂, 18♀, 27N
Rattus rattoides	15	9♀, 17N
Rattus nitidus	3	1♂, 5♀
Rattus rattus rufescens	2	1♀, 6N
Rattus sp.	4	1♀, 4N
Bandicota bengalensis	1	1N
Apodemus flavicollis	17	6♂, 43♀, 61N
Mus musculus	22	1♂, 24♀, 27N
Alitcola roylei	4	1♂, 5♀, 12N
Suncus murinus	7	2♂, 6♀, 9N
Passer domesticus	1	1N
Pycnonotus cafer	1	2N

LOCALITIES: *Jammu & Kashmir* : *Ladakh*: Kargil, Dumgal, Fraw, Leh, Bodhkharbu (3400 m); *Doda*: Bhadarwah, Khilani; *Udhampur*: Phalata. *Himachal Pradesh*: *Chamba*: Rakh, Sindwadi (3000 m), Tissa; *Lahul & Spiti*: Keylong, Yongkirting, Kaza (3650 m), Morang; *Kangra*: Baghany, Dugadda at Hamirpur; *Mandi*: Gutkar; *Simla*: Simla, Dassumajara, Malkumajara, Pud at Nalagarh (600 m); *Mahasu*: Nirith, Sarhan, Gangtoli at Rohru, Chool, Darhar, Jagat-Khana, Jeori, Bhagi; *Sirmur*: Moginand. *Uttar Pradesh*: *Almora*: Gania Deoli (1800 m); *Chamoli*: Guliyo, Dogalbita; *Dehra Dun*: Satyanarayan; *Tehri*: Ghansali; *Uttarkashi*: Jnanasu.

34. **Dermanyssus gallinae**

The common fowl mite found in temperate and tropical zones. Apparently an obligate parasite of birds (Strandtmann and Wharton 1958).

Present records:

Host	No. of coll.	Specimens coll.
Passer domesticus	2	2 ♀
Parus major	1	2 ♀
Rattus sp.	1	1 ♀

LOCALITIES: *Jammu & Kashmir*: *Ladakh*: Pratapgunj (2700 m), Kargil. *Himachal Pradesh*: *Chamba*: Pukhri (1150 m).

35. **Dermanyssus** sp.

1 ♀ ex *Dendrocopos auriceps* was collected at Naggar, Kulu Dist., Himachal Pradesh on 20 Apr. 1968. The identity of the specimen has not yet been determined.

36. **Myonyssus** sp.

A single female specimen was collected from *Ochotona roylei* at Salgran (2650 m), Chamba Dist., Himachal Pradesh on 20 Sept. 1968.

37. **Eulaelaps indiscretus**

This species was described ex *Apodemus flavicollis, Crocidura* sp. and *Rattus* from Pakistan by Allred (1969).
Present records:

Host	No. of coll.	Specimens coll.
Rattus rattoides	2	1 ♂, 7 ♀
Rattus fulvescens	1	1 ♀
Apodemus flavicollis	31	3 ♂, 78 ♀
Alticola roylei	1	1 ♀
Suncus murinus	1	1 ♀

LOCALITIES: *Jammu & Kashmir*: *Baramulla*: Rampore. *Himachal Pradesh*: *Chamba*: Tindi; *Mahasu*: Ratanadi at Baghi, Sungri; *Kinnaur*: Sangla, Rakcham, Chitkul. *Uttar Pradesh*: *Naini Tal*: Mukteshwar; *Pauri*: Dogadda; *Chamoli*: Badrinath.

Notes: The species has a wide ecological range from tropical to alpine in distribution. This is the new record in India.

38. **Eulaelaps stabularis**

This is the oldest known species under the genus. The species has a very wide distribution and has been recorded from North Africa, Europe, Asia and North America. The recorded hosts include several species of rodents, insectivores and birds (Strandtmann and Wharton 1958).
Present records:

Host & habitat	No. of coll.	Specimens coll.
Rattus rattoides	9	1 ♂, 13 ♀
Rattus rattus	2	3 ♀
Rattus rattus gangutrianus	1	1 ♀
Rattus rattus rufescens	1	1 ♀
Rattus (*Millardia*) *meltada*	1	1 ♀
Bandicota bengalensis	1	1 ♀
Apodemus flavicollis	20	3 ♂, 27 ♀
Mus musculus	24	30 ♀
Mus platythrix	1	1 ♀
Mus sp.	1	1 ♀
Alticola roylei	4	4 ♀
Suncus murinus	1	2 ♀
Cattle shed	3	1 ♂, 14 ♀, 13N

LOCALITIES: *Jammu & Kashmir*: *Ladakh*: Kargil, Dumgal, Drass; *Anantnag*: Pehalgam; *Baramulla*: Rampore, Chektreran, Sopore, Marder; *Doda*: Bhadarwah, Khilani; *Udhampur*: Dehari. *Himachal Pradesh*: *Chamba*: Salooni, Tindi; *Lahul & Spiti*: Keylong, Thirot, Chhetru; *Kangra*: Baijnath; *Kulu*: Palchan at Manali, Naggar, Largi; *Mahasu*: Pipty and Rachauli near Rampur, Dukolad, Khotkai, Chool near Khotkai, Ratanadi near Baghi, Sungri, Baghi; *Kinnaur*: Sangla, Baring-Suring near Sangla (2700 m), Chitkul, Rakcham. *Uttar Pradesh*: *Naini Tal*: Mukteshwar; *Pauri*: Dogadda; *Chamoli*: Badrinath.

Note: This is the new record in India.

39. **Haemogamasus gyrinodes**

The species was described from Pakistan ex *Alticola roylei.*

Present record: 1 ♀, ex *Apodemus flavicollis,* Chitkul (3400 m), Kinnaur, Himachal Pradesh, 22 June 1970.

Note: This is the new record of this mite in India.

40. **Haemogamasus nidiformes**

The species was described and recorded from Europe and Asia — U.S.S.R., ex *Microtus gregalis* by Eregetova (Strandtmann and Wharton 1958). Recorded from Pakistan by Allred (1969) and from Turkey by Garrett and Allred (1971).

Present records:

Host	No. of coll.	Specimens coll.
Rattus rattoides	3	6 ♀
Rattus fulvescens	1	1 ♀
Alticola roylei	1	1 ♀
Apodemus flavicollis	5	7 ♀, 1N
Mus musculus	1	1 ♀
Ochotona roylei	1	1N
Suncus murinus	1	1 ♂, 2 ♀
Crocidura sp.	1	1 ♀

LOCALITIES: *Jammu & Kashmir*: *Baramulla*: Chektreran. *Himachal Pradesh*: *Kulu*: Vaishista at Manali; *Lahul & Spiti*: Chhetru, Thirot; *Mahasu*: Ratanadi at Baghi, *Kinnaur*: Sangla, Chitkul. *Uttar Pradesh*: *Naini Tal*: Mukteshwar, Latoli, *Pithoragarh*: Milan; *Chamoli*: Dogalbita, Baniakund.

Note: This is the new record in India.

41. **Tinaminyssus** sp.

Very little information is available on the Rhinonyssid mites of Indian birds. The field remains open for the acarologists.

Present record:

Host	No. of coll.	Specimens coll.
Psittacula cyanocephala	1	10 ♀
Garrulax erythrocephala	1	3 ♀

LOCALITIES: *Himachal Pradesh*: *Mandi*: Gutkar, on 21 May '67. *Uttar Pradesh*: *Chamoli*: Wan (2500 m), on 18 Oct. '67.

42. **Spinturnix pindarensis**

The species was described on the specimens collected from *Myotis siligorensis* in Kumaon and Garhwal regions of Uttar Pradesh during the present survey (Bhat 1973b).

Additional records:

Host	No. of coll.	Specimens coll.
Myotis siligorensis	2	1 ♂, 2 ♀, 1N
Nyctalus leisleri	1	1 ♂

LOCALITIES: *Himachal Pradesh*: *Kulu*: Kothi. *Uttar Pradesh*: *Chamoli*: Dogalbita.

Notes: The specimen from *N. leisleri* slightly differs from the type specimens by the absence of shoulders on the sternal plate, otherwise identical with type specimens in all other characters.

43. **Spinturnix plecotinus**

Described by C. L. Koch (1839) from *Plecotus auritus* in Europe. Since then the species has been recorded from several European countries from the type host-species. There is one record from *Nyctalus noctula* (Rudnick 1960).

Present records:

Host	No. of coll.	Specimens coll.
Plecotus auritus homochrous	2	4♂ and 1♀

LOCALITIES: *Himachal Pradesh*: *Mahasu*: Ratanadi near Baghi. *Uttar Pradesh*: *Pithoragarh*: Martoli (3500 m).

Notes: This is the first record from *P. a. homochrous* in India.

44. **Spinturnix** sp.

The species closely resembles *Spinturnix paracuminatus* Baker and Delfinado, 1964, described from *Miniopterus* sp. and *Pipistrellus* sp. in Borneo and New Guinea, but differs from it by the absence of tritosternum. The species awaits description.

Present Record:

Host	No. of coll.	Specimens coll.
Pipistrellus babu	1	1♂, 2♀

LOCALITY: *Uttar Pradesh*: *Tehri*: Ghonti.

45. **Paraperiglischrus rhinolophinus**

This species was first described under the genus *Periglischrus* as *P. rhinolophi* by Hiregaudar and Bal (1956) on the basis of specimens collected from *Rhinolophus rouxi*, and later transferred under the new genus *Paraperiglischrus* and synonymised with the species *P. rhinolophinus* (C. L. Koch, 1841) by Rudnick (1960).

Present record:

Host	No. of coll.	Specimens coll.
Rhinolophus rouxi	1	1♂, 5♀

LOCALITY: *West Bengal*: *Darjeeling*: Tashiding.

Notes: Apparently several taxa have been included under this species due to the absence of differentiating characters. But the specimens collected from different host species show consistent difference in size. The species appears to be polyvalent and needs revision.

46. **Paraperiglischrus** sp.

Records:

Host	No. of coll.	Specimens coll.
Hipposideros armiger	1	2♂, 1♀

LOCALITY: *Uttar Pradesh*: *Almora*: Katarmal.

Notes: The specimens collected from this host are distinctly larger than all the known taxons under the genus and await description.

47. **Ancystropus eonycteris**

The species was described by Delfinado and Baker (1963) ex *Eonycteris robusta* from Mindanao. It is similar to *Ancystropus zeleborii* in general morphology, but the leg I lacks lateral hooks on distal 4 segments; femur I and genu I each with only 1 large ventral projection; and the ventral setae on region above and shield strong and stout.

Present record:

Host	No. of coll.	Specimens coll.
Eonycteris spelaea	1	2♀

LOCALITY: *Uttar Pradesh*: Pithoragarh: Thal.

Notes: This is the first record of this species in India. *Ancystropus nakatae* described on the basis of a single mutilated female specimen by Prasad (1969b) is identical with *A. eonycteris* and is obviously a synonym.

48. **Ancystropus kanheri**

This species was first described by Hiregaudar and Bal (1956) under the genus *Ancystropus* on the basis of specimens collected from *R. leschenaulti* from India. Delfinado and Baker (1964) recorded this species ex *R. amplexicaudatus* from Philippines, O. Sumba and Solomon Islands; and ex bats from New Guinea. They transferred this species under a new genus *Oncoscelus.* Prasad (1969a) recorded the species from Philippines ex *R. amplexicaudatus.* Domrow (1972) brought back the species under the former genus *Ancystropus* because of its striking similarity to other co-generas. He also recorded this species ex *R. stresemanni* from New Guinea.
Present records:

Host	No. of coll.	Specimens coll.
Rousettus leschenaulti	8	15♀, 2N

Localities: *Himachal Pradesh*: *Kulu*: Sooma, Bandrol; *Kangra*: Dadh. *Uttar Pradesh*: *Pauri*: Dalmisain; *Almora*: Kapkote; *Pithoragarh*: Thal.

49. **Ancystropus taprobanius**

This species was originally described from *Rousettus seminudus* from Ceylon. Later redescribed from *R. leschenaulti* by Hiregaudar and Bal (1956) under the name *A. indicus* and from *Rousettus* sp. by Baker and Delfinado, 1964 under *A. rudnicki.* Prasad (1969a) recorded some more material from New Guinea and Philippines under *A. rudnicki.* Both the latter species are synonymised with *A. taprobanius* by Domrow (1972), who records this species from *R. stresemanni.*
Present records:

Host	No. of coll.	Specimens coll.
Rousettus leschenaulti	16	81♀

Localities: *Himachal Pradesh*: *Kangra*: Dadh; *Kulu*: Sooma, Bandrol; *Mandi*: Gutkar. *Uttar Pradesh*: *Pauri*: Raitoli, Shrinagar, Dalmisain; *Almora*: Kapkote, Kataithbara; *Naini Tal*: Dugada; *Pithoragarh*: Patet, Tejam, Thal.

50. **Ancystropus zeleborii**

Recorded from Egypt and Cyprus ex *Rousettus aegyptiacus*, Uganda ex *Lavia pons rex*, Thailand ex bat, and India ex *R. leschenaulti* (Rudnick, 1960). *A. palawanensis* Delfinado and Baker (1963) is synonymised with *A. zeleborii* by Domrow (1972).
Present records:

Host	No. of coll.	Specimens coll.
Rousettus leschenaulti	22	8♂, 59♀, 1N
Cynopterus sphinx	10	28♀
Sphaerias blanfordi	11	11♂, 28♀, 6N

Localities: *Himachal Pradesh*: *Kulu*: Sooma, Bandrol; *Kangra*: Dadh; *Mandi*: Mandi; *Bilaspur*: Ballu. *Uttar Pradesh*: *Naini Tal*: Dugada, Garjia, Haldwani; *Almora*: Kapkote, Khati, Loharkhet, Phaltaniya, Kataithbara; *Pithoragarh*: Dharchula, Kotera, Kuity, Tejam, Dummer, Khela, Thal, Aat; *Pauri*: Dungripanth, Narkota, Raitoli, Dalmisain; *Chamoli*: Guliyo, Dogalbita; *Sahranpur*: Fatehpur; *Dehra Dun*: Ramgarh, Sahasradhara.

Notes: *C. sphinx* and *S. blanfordi* are the two new hosts recorded.

51. **Meristaspis lateralis**

Recorded from Egypt, Palestine and Cyprus ex *R. aegyptiacus;* from Ceylon ex *R. seminudus* (Rudnick, 1960); from India ex *R. leschenaulti* (Hiregaudar and Bal, 1956); from Yemen ex *Eidolon sebaem* (Rudnick, 1960); from Philippines ex *E. robusta, R. amplexicaudatus* and *C. brachyotis;* from New Guinea ex *Rousettus* sp. and on undetermined sp. of bat;

from N. Borneo ex *Tupaia;* and from Timor ex an undetermined host species (Delfinado and Baker, 1963; Baker and Delfinado, 1964); and again recorded from New Guinea ex *R. stresemanni* (Domrow, 1972).

Present records:

Host	No. of coll.	Specimens coll.
Rousettus leschenaulti	29	97♂, 171♀,36N
Eonycteris spelaea	2	7♀
Cynopterus sphinx	2	1♀, 2N
Sphaerias blanfordi	12	8♂, 49♀, 32N
Pteropus giganteus	1	1♀

LOCALITIES: *Himachal Pradesh*: *Kulu*: Sooma, Bandrol; *Kangra*: Dadh; *Mandi*: Mandi. *Uttar Pradesh*: *Naini Tal*: Dugada; *Almora*: Kapkot, Dhakuri, Loharkhet, Phaltaniya, Kataithbara; *Pithoragarh*: Dharchula, Kuity, Patet, Tejam, Girgaon, Khela, Tawaghat, Thal; *Pauri*: Dungripanth, Narkota, Raitoli, Shrinagar, Dalmisain; *Chamoli*: Dogalbita; *Dehra Dun*: Sahasradhara, Sahaspur.

Notes: New record from *E. spelaea, C. sphinx* and *S. blanfordi* in India.

52. **Nothroholaspis** sp.

Nothroholaspis sp. are extremely common and are found in the soil and on invertebrates and vertebrates. Although they are regularly associated with various hosts they are probably not parasitic in the actual sense (Baker and Wharton 1952).

Present records:

Host and habitats	No. of coll.	Specimens coll.
Man	1	1N
Cattle shed	3	17N
Chicken coops	1	1N
Rattus rattus gangutrianus	1	1♀, 1N
Suncus murinus	1	1♀

LOCALITIES: *Himachal Pradesh*: *Kulu*: Palchan; *Kinnaur*: Chitkul, Baring Suring at Sangla, Sangla, Bilaspur: Deoli. *Uttar Pradesh*: *Pithoragarh*: Aat. *Sikkim*: Gangtok (1500 m).

53. **Boydaia** sp.

27 specimens were collected from the nasal chambers of Blueheaded rock thrush (*Monticola cinclorhynchus*) at Sundargaon (1100 m) near Karnaprayag, Chamoli dist., Uttar Pradesh, on 14th May 1967.

54. **Pterygosoma** sp.

The family Pterygosomidae, for the most part, are parasites of lizards, usually being found beneath the scales of their host. Very little is known about their biology (Lawrence 1935, 1936). Indian Pterygosomidae still awaits systematic study.

Present records:

Host	No. of coll.	Specimens coll.
Agama tuberculata	3	6L, 8N, 13♂, 18♀

LOCALITIES: *Himachal Pradesh*: *Kulu*: Naggar. *Uttar Pradesh*: *Pithoragarh*: Lilam, Thalkedar.

DISCUSSION

The present survey lists 54 species of mites, of which 52 are Mesostigmatid mites. A number of species recorded here need confirmation of their identity, some of which are apparently new species.

Among the Mesostigmatid mites most of the species, except Spinturnicidae, *Laelaps* spp. and *Sauronyssus,* did not show a close host specificity at the species level. *Laelaps* spp. have been observed to have some host specificity at the specific or generic level of the host. While the family Spinturnicidae did show a high degree of host specificity by having associated with one or a few species of Chiropteran hosts.

The species of *Ornithonyssus, Steatonyssus, Pellonyssus, Liponyssoides, Dermanyssus* and *Haemogamasus* were found to have fresh blood within them and are obviously haematophagous parasites. Actual blood was not observed in other species of Mesostigmatid mites.

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BIOLOGY OF HOUBARA BUSTARD (*CHLAMYDOTIS UNDULATA MACQUEENI*) WITH REFERENCE TO WESTERN BALUCHISTAN[1]

Afsar Mian[2] and Mohammad Ibrahim Surahio[3]

(*With two text-figures*)

INTRODUCTION

The Asian race of Houbara Bustard (*Chlamydotis undulata macqueeni*) mainly breeds in Kirgiz steppes of USSR, as far as Mongolia and migrates in winter to Iran, Afghanistan, Pakistan and part of India (Collar 1979). Pakistan receives one of the largest wintering populations of this bird and is found in high densities of about four birds per ten square miles (Goriup 1981). The vast desolate steppes of western Baluchistan, spread over thousands of square kilometre is said to receive a reasonable proportion of the total population of this bird, wintering in Pakistan.

There is a general feeling that the wintering population of Houbara is declining at an alarming rate and that there is an eminent need for conservation (Goriup 1980). However, whereas effective conservation needs an elaborate study of the biology and distribution of the wintering population of the bird, very few studies are presently available (Mirza 1971; Sorahio 1981, 1982), and only certain guess estimates exist for Baluchistan. These facts and the presence of a sizeable population alongwith the existence of certain optimistic speculations regarding the residential nature of Houbara in Baluchistan prompted us to collect first hand information regarding the population of the bird wintering in the area. This paper attempts at presenting a preliminary report regarding the biology and ecology of the bird with particular reference to Baluchistan.

METHODS AND MATERIAL

An extensive tour of western Baluchistan was undertaken in April, 1982, with the active collaboration of the Baluchistan Forest Department in order to collect first hand information on the biology and ecology of Houbara in various wintering grounds of western Baluchistan and to ascertain whether the birds breed in the area. For this purpose Dasht area of Mustung; Dak plains spread along the border area around Inam Bostan; Zangi Nawer area towards northwest of Nushki; the vast plains along the road from Nushki to Sathiar, the vast plains in remote areas of Chagai and the plains around Yakmuch, falling in Chagai district were visited. Similarly the vast plains of Gwash, Padak, Jalawar, Hurmagai and Washuk of Kharan district were also toured. Local people, forest staff and watchers and reputed shikaris were contacted and were questioned regarding feeding habits, population dynamics, migration patterns and routes, local techniques pertaining to capturing the live bird, hunting bag data of the hunters from Middle East and Gulf States, and evidences of breeding activities in the area. While analysing the data, due importance was given to the status of the informer

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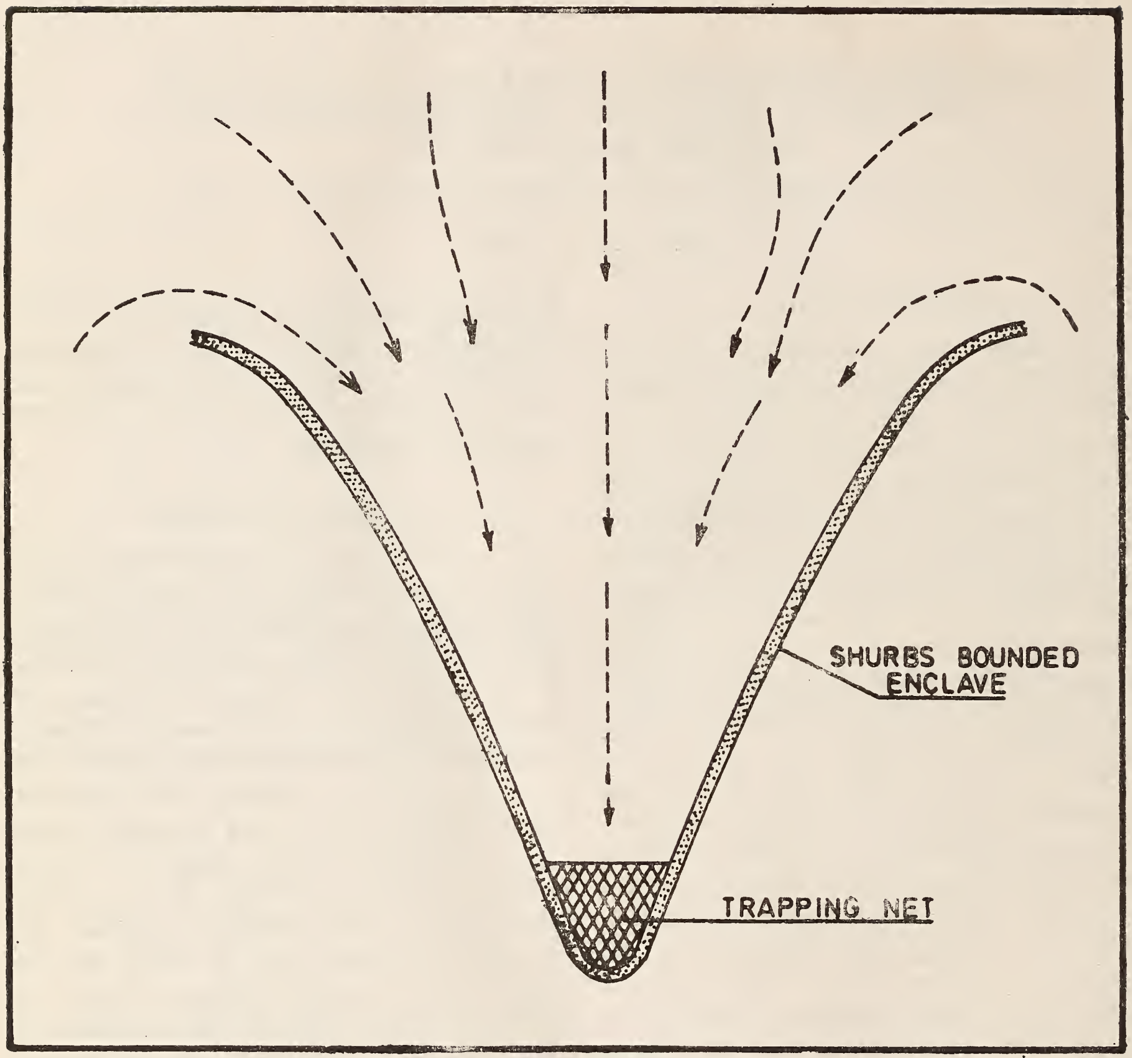

Fig. 1. A line sketch of the enclosure, used by local people of the western Baluchistan for live trapping of Houbara.

and data lacking a consensus of opinion were excluded from the final analysis. The topography and the distribution of vegetation of the wintering grounds were examined by us.

RESULTS AND DISCUSSIONS

Habit: Houbara is basically a very shy bird and avoids human interference. However, it is approachable within reasonable shooting distance on camel back or from behind a herd of slowly moving camels. This finding is in conformity with similar observations reported by Ali and Ripley (1969). It is generally believed that the bird is not scared of slow mov-

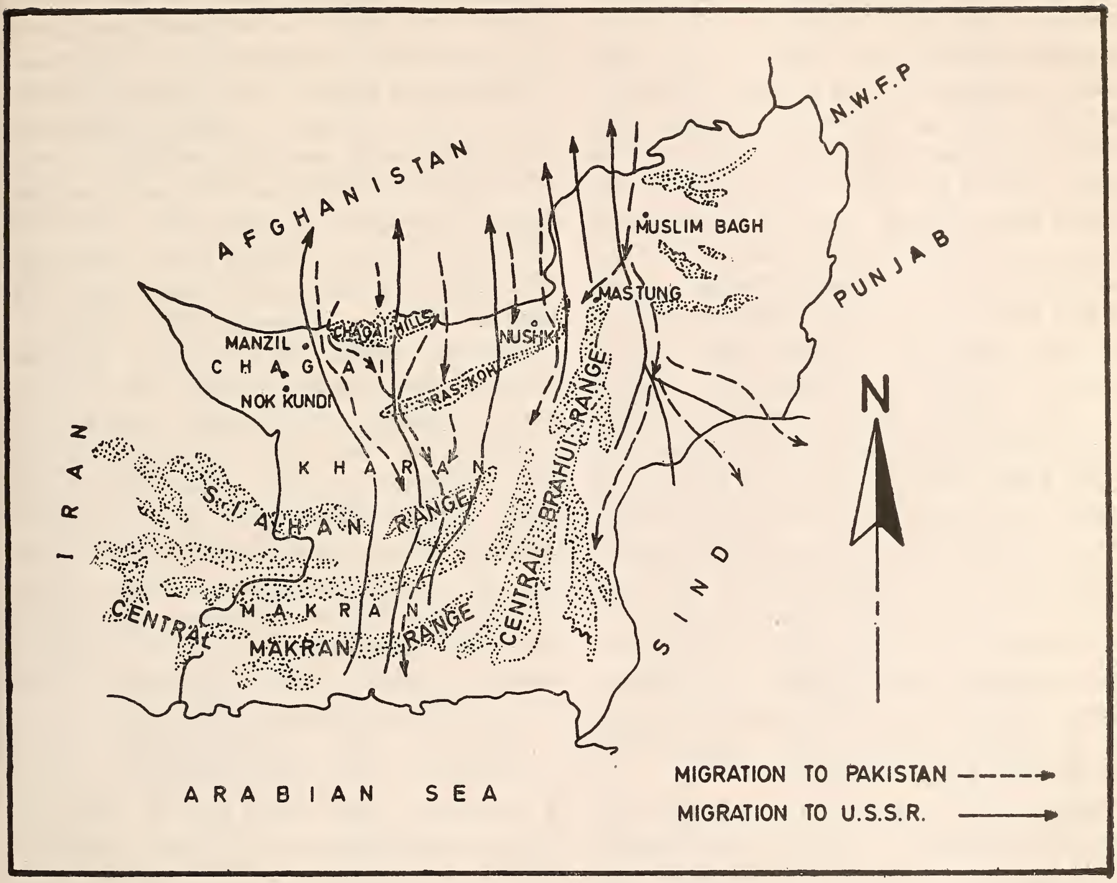
AFGHANISTAN
N.W.F.P
MUSLIM BAGH
PUNJAB
MASTUNG
MANZIL
CHAGAI HILLS
NUSHKI
CHAGAI
NOK KUNDI
RAS KOH
KHARAN
BRAHUI RANGE
IRAN
SIAHAN RANGE
CENTRAL
MAKRAN
CENTRAL MAKRAN RANGE
SIND
N
ARABIAN SEA
MIGRATION TO PAKISTAN
MIGRATION TO U.S.S.R.

Fig. 2. A line sketch of Baluchistan depicting the probable migration routes of Houbara.

ing larger objects and is said to take little notice of a gradually approaching man, camouflaged in a haphazard tented structure. The bird can be captured alive by forming a special triangular trapping enclosure. The blind and narrow end is provided with a suitable trapping net. The boundaries of the net and the further extensions are bounded by locally available shrubs, specially by *Haloxylone ammodendron,* locally known as Tagaz (Fig. 1). The birds are then gradually driven towards the open and wider end of this enclosure by riding on a camel back and are then further pushed deep into the net, where the bird gets trapped.

Houbara is solitary in nature and occurs in a dispersed population in accordance with the availability of protection and food, except at the time of migration. However, it appears that the bird probably does not exhibit territorial behaviour and some 4-5 birds can be seen together under good conditions of food and shelter. The call of the bird has never been heard. This confirms the earlier report of Ali and Ripley (1969).

Habitat and Distribution in Baluchistan: Houbara is very widely distributed in Western Baluchistan, which is an extensive cup shaped valley surrounded by high mountain ranges on three sides leaving a northern open area which extends deep into Afghanistan (Fig. 2). The eastern side of the valley is traversed by the Central Brahui Range while the southern and western sides are partially bounded by two parallel ranges, i.e. the Siahan Range and the Central Makran Range. The western side has Kuh-i-Birg and Kuh-i-Tuftan, which extend deep into Iran with an northwestern orientation. The western range is further supported by an extremely arid tract from west of Nok Kundi. Within this valley, there are two isolated ranges of mountains with an east-west orientation, i.e. Chagai Hills in the north and Raskoh in the central area. Topographically, most part of this valley is an extensive plain having sandy soil sometimes with loose stones. Generally the plains gradually slope towards the mountain ranges. The vegetation of the area includes certain xerophytic shrubs, various annual herbs and scattered grasses (Table 1).

During winter, the Houbara is widely distributed, preferably in open plain steppes, having sandy or loose stony background with small shrubs, which offer sufficient protection and camouflage from predators, especially man, and through which the bird can see from a long distance an approaching predator. It generally avoids hilly terrain though it inhabits the uneven plains in the vicinity of a hill range, having dried water courses, which provide shelter from sun and human predation. It lives in comparatively arid uncultivated areas, away from human populations, without caring for water. The bird has never been seen in the vicinity of water bodies or while drinking water. It is expected that the bird mainly depends upon the metabolic water for the purpose of its water requirements. Further studies on the adaptations of the bird to the arid conditions could yield interesting information. The vast plains of Baluchistan provide ideal wintering grounds for the bird, having a sparsely distributed human population, sparse but sufficient amount of vegetation for feeding activities and a camouflaging background of sandy buff coloration of the soil. All these features are in conformity with similar reports regarding Punjab and Sind (Ali and Ripley 1969, Sorahio 1981, 1982).

From the initial studies it seems that the Plains around Kharan are rich with the wintering population of Houbara, followed by Yakmuch and Chagai plains. The birds are present abundantly in Dak, Zangi Nower and Dasht area in October but their population decreases in the area by December, and in the later period these areas have a scanty population. Further detailed studies are still needed about the population levels of the different areas, to prepare reliable concentration maps of the wintering population of the bird.

Migration: The probable migration routes for Houbara are presented in Fig. 2. A look at the figure would reveal that the migration routes in Baluchistan are very much dispersed. This is in conformity with an earlier guess (Goriup 1980). The Houbara exhibits a north-south migration from the various adjacent areas of Afghanistan right from Muslimbagh to the western side of Chagai upto Manzil. The first batch of the migrating birds is said to enter Baluchistan in late September or early October, depending upon the conditions of temperature. It first reaches the areas located in vicinity of Pak-Afghan border, i.e. Muslimbagh, Dak plains (Inam Bostan), Zangi Nawer (northwest of Nushki) and whole of the Chagai plains. They stay there, consuming the available food and gradually move southwards to Dasht plains of Mustung, Kharan and Yakmuch area. Some

TABLE 1

A COMPARATIVE STATEMENT OF THE TOPOGRAPHY, BACKGROUND SOIL, VEGETATION AND APPROXIMATE PERIOD OF STAY OF HOUBARA BUSTARD IN THE CERTAIN LOCALITIES OF WESTERN BALUCHISTAN

Sl. No.	Locality	Topography	Background Soil	Vegetation	Approximate period of stay of Houbara
1.	Dasht plains (Mustung valley).	Large open valley in Central Brahui Range, Sandy loam, and sand dunes with slopes.	Clay-sand, mixed with stones.	1. *Haloxylon ammodendron* 2. *Malcolmia africana* 3. *Atriplex* sp. 4. *Polygonum afghanicum* 5. *Heliotropium* sp. 6. *Arnebia* sp.	November-March.
2.	Dak plains (North east of Nushki)	Vast plains, having sparsely distributed sand dunes.	Sandy.	1. *Calligonum comosum* 2. *Koeleria phleoides* 3. *Malcolmia africana* 4. *Haloxylon ammodendron* 5. *Ephedra* sp. 6. *Artiplex dimorphostegia* 7. *Polygonum afghanicum* 8. *Panicum* sp.	October-November.
3.	Zangi Nawar plains (N. W. of Nushki)	Vast sloping plains, bounded by small hill tracts. Salt water lake surrounded by sand dunes.	Sandy.	1. *Calligonum comosum* 2. *Salsola arbuscula* 3. *Haloxylon ammodendron*	October-December.
4.	Chagai plains.	Large sloping plains, extending from the northern Chagai Hills. Traversed by hilly tracts of varying heights and water Channels.	Black loose stony with sand.	1. *Artemisia* sp. 2. *Calligonum comosum* 3. *Haloxylon ammodendron*	November-March.
5.	Yakmuch plains. (Chagai district)	Vast plains, extending towards northern side of Raskoh and gradually extend deep upto Chagai Hills.	Loose sandy with some clay and stones.	1. *Calligonum comosum* 2. *Haloxylon ammodendron* 3. *Tribulus* sp. 4. *Erodium* sp. 5. *Rhazya stricta* 6. *Holosteum umbellatum*	November-March.
6.	Plains of Gwask, Padak, Jalawar, Hermagai and Washuk (Kharan district).	Vast plains between Raskoh and Siahan Range.	Loose sandy with some clay and stone.	1. *Calligonum comosum* 2. *Haloxylon* sp. 3. *Malcolmia africana* 4. *Atriplex* sp. 5. *Tribulus* sp.	December-March.

of the Kharan and Yakmuch populations may further move southwards to the coastal areas of Makran. The Dasht population may move southwards and thence finally going to Sind. The bird is said to follow almost the same routes, while migrating back to their residential areas in USSR, in March. Ringing data is needed to confirm these findings. There is very little evidence in favour of the immigration of Houbara into Baluchistan, from adjacent areas of Iran. In this regard our findings differ from an earlier report (Anon. 1972), which predicts that the major migrating population enter Makran, Kharan and Chagai districts from Iran, which bifurcate at Mach so that one group move towards Sind, while the other towards northern Baluchistan. However, possibilities for such a migration directly to the southern coastal area cannot be completely ruled out.

Houbara is said to enter Baluchistan in groups of 10-15 birds, having a slower southward movement. They usually rest after every 1-2 miles, consuming the available food and gradually disperse in the area alongwith their southward movement. The bird migrates during night, spending the day in various hideouts. The arrival of the Houbara in the northern areas of Baluchistan seems to be well coordinated and synchronized, as it is usually believed that one could see many birds in Dak and Chagai plains on one fine morning of the September/ early October, whereas there was hardly any in the previous evening. However, birds keep arriving for the next 15-20 days. It seems that the further southward movement of the bird is mainly in response to the availability of food and in search for better and unutilized feeding grounds.

The migration of birds, back to their residential areas in USSR, is said to be in larger groups of 20-30 birds. During this migration, the bird is said to take much longer stretches of flight and generally passes over the various areas falling in their route without stopping.

Food and Feeding Habit: Houbara is omnivorous and nocturnal in habit and is said to consume whatever is available. Thus the food of the bird varies with type of the vegetation in the area and the season. It is said to depend upon the seeds, and the young shoots of *Calligonum comosum* (Phog), *Koeleria phleoides* (Gayab), *Malcolmia africana* (Chammar), *Haloxylon ammodendron* (Tagaz), *Ephedra* sp. (Gomazg), *Salsola arbuscula* (Narrunk) and *Polygonum afghanicum,* in Dak, Zangi Nower and Kharan area. The Houbara prefers the dry seeds of *Polygonum afghanicum, Calligonum comosum, Haloxylon ammodendron* and *Panicum* sp. in these areas. In Chagai and Yakmuch plains the bird consumes *Tribulus terrestris* (Sarang), *Tribulus alatus* (Korka), *Erodium* sp., *Plantago ciliata, Rhazya stricta,* and *Holosteum umbellatum.* Though certain detailed quantitative studies of the stomach contents of the bird, at different times, are needed in order to work out the food preferences of the bird in different areas, the present information can prove helpful in organizing such studies. A comparison of these studies with the reports of Mirza (1971), regarding Punjab and Sorahio (1981), regarding Sind reveals that *Haloxylon, Tribulus* and *Crotalaria* are the preferred food of Houbara, which is consumed everywhere.

Population Levels and Hunting Stress: The partial hunting bag data collected by officials of Baluchistan Forest Department from visiting foreign hunters for Chagai and Kharan districts suggests that the bird is present in high densities in western Baluchistan, specially in certain areas of favourable habitat. Our initial calculations reveal that the wintering Houbara in the area is present around one bird per 3.0 square kilometre. Comparing this figure with the one suggested by Goriup (1981) for Punjab and

Sind, i.e. one bird per 6.25 square kilometre, suggests that this area is richer in Houbara. A detailed population census is required to know exact biological potentials of this population of the bird and to construct certain reliable concentration maps for the area.

The initial information collected from the officials of the forest department, local people and the reputed hunters, present in the area; suggest that population of Houbara, wintering in remote areas of western Baluchistan is also under a tremendous hunting pressure. According to some very conservative estimates the total hunted birds during the year 1981-82 can be any figure between 2,000 to 3,000. The exact effect of this heavy hunting toll on the population is hard to be assessed with the limited information available regarding the population size and population structure; but such a figure sounds too high for the bearable limits of the population wintering in the western Baluchistan.

Breeding: There are certain reports in literature regarding the presence of the breeding activities of the bird in Chagai, Kharan and Makran areas (Ali & Ripley 1969, Roberts & Savage 1971 and Siddiqi 1972). We tried our best for some evidence in favour of occurrence of this activity of the bird in the area, however, we could not find convincing proof of egg laying and nesting in Chagai, Kharan and Nushki areas. During our tour some enthusiastic workers and hunters did report the presence of some very sporadic cases of nesting and breeding in Booto Jungle (a protected reserve forest near Nushki); towards the north of Chagai, adjacent to Afghanistan border; Yakmuch plains. However, we could not physically ascertain these reports though it was an egg laying season for the bird. In the light of the available information, it seems that the chances of breeding of Houbara in the area are very remote, and even if, at all, occasional breeding occurs in the area, it is a chance occurrence and sparse. The available information on the breeding activities in the coastal areas of Makran are not very conducive (Hamidullah 1982).

It seems that the major support for the belief in the breeding of Houbara in the area mainly emerges from the fact that *C. undulata undulata* (the African race of Houbara) can breed in similar inhospitable hot and arid conditions and that there are high densities of this bird in unapproachable areas of Baluchistan. However, it seems that *C. undulata macqueeni* (the Asian race of Houbara) is adapted to a colder climate and hence it breeds at higher latitudes in USSR or Afghanistan.

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THE FOOD AND FEEDING OF JUVENILE BENGAL MONITOR LIZARDS (*VARANUS BENGALENSIS*)[1]

WALTER AUFFENBERG[2] AND IPE M. IPE[3]

A sample of 29 juvenile *Varanus bengalensis* were examined for prey remains in the gut. Results show that most probably find several individuals of about two species of insect prey per day. While both sexes take the same prey species, males caputure a somewhat higher number of prey items per unit time. The most common prey are orthopterans and coleopterans. Weight of individual prey to predator weight is .0169:1 — a low ratio when compared to that known for other monitors, but probably due to the insectivorous feeding habits of the *Varanus bengalensis* juveniles.

INTRODUCTION

During September to December, 1979, the senior author was afforded the opportunity to study several aspects of the ecology and habits of two species of monitor lizards in northern India—*Varanus bengalensis* and *V. flavescens.* One of the projects suggested by the available material was a study of the food habits of *V. bengalensis.* This paper is the result of a joint study of that material by the two authors.

The study was prompted by (1) the fact that extremely little information is available regarding the food of juvenile varanids of any species (though the species studied by Pianka, 1968, 1970, 1971), are all less than 1 m total length, and (2) what little information is available on the food of varanid lizards is largely in the form of prey lists (Stirling 1912, Burden 1928, Waite 1929, Cowles 1930, Zakhidov 1938). Few publications concerning the feeding of varanids provide data useful in determining their predatory strategy; exceptions are Dryden (1965), Pianka (1968, 1970, 1971), and Auffenberg (1981).

Most published food data for *Varanus bengalensis* are very general (Smith, H. 1931, Deraniyagala 1931, Smith, M. 1935, Minton 1966). The most detailed study is that by Sharma and Vazirani (1977). In no case are results based on an examination of more than five individuals. The following study is based on the food remains found in the digestive tracts of 29 juvenile Bengal monitor lizards and records several previously unknown facets of the feeding biology of this species. While the number of specimens examined may be considered small, and the fact that they were obtained from supply houses less than entirely satisfactory, the chances of obtaining more material of this species (listed as endangered in IUCN Red Data Book and protected by Indian law) is extremely remote.

METHODS AND MATERIALS

After the law protecting *Varanus bengalensis* was passed, several Indian biological supply houses in the Agra area were left with a number of preserved individuals originally intended for sale to university anatomy classes. Because

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the species could no longer be sold, most supply houses discarded their stock of preserved *V. bengalensis* several years ago; some did not, and most of these had apparently been forgotten in the interim. The senior author visited each of these supply houses and requested that their old stocks of preserved specimens of this species be donated to this scientific project. Several houses generously responded, so that 29 juveniles were accumulated. They were sexed, measured, examined for a number of scale characters, and then dissected to obtain data on food in the gut.

Average snout vent length (= SVL) of the sample studied was 180 mm (range 155-286) and Av. weight 124.7 g. There was no significant difference in either SVL or weight between males and females. Estimated age of individuals in the sample was one year. The sex ratio was 1:1.

Stomach contents were kept separate from those of the large intestine of each individual. The food remains (often completely macerated) in each of these collections were identified as closely to species as possible.

Estimates of the number of individuals of each of the prey species eaten were based on the number of identical anatomical parts. The weight of prey species were obtained by weighing a sample of five average-sized complete adult specimens of each of these prey species.

RESULTS

Number of Prey.—Only two lizards contained food in the stomach, suggesting that few individuals had eaten in the 48 hours previous to capture. On the other hand, 59.6 per cent of the lizards contained food remains in the large intestine. Assuming gut passage rate in *V. bengalensis* is the same as in *V. komodoensis* (4-6 days, 96-114 hr; Auffenberg 1981), over half had eaten during the last several days before they were killed.

The number of prey *items* in the two stomachs were 3 and 14. The number of prey species per stomach were 2 and 8. These data suggest that each daily feeding foray usually results in the capture of several different prey species, each represented by several individuals.

In those monitors containing food in the large intestine, the number of prey items varied from 1 to 273. The highest item numbers were represented by two cases in which many ants had been eaten. When these are excluded the prey items per individual range from 1 to 27 (Av. = 14.14). If this prey load represents a maximum of 6 days, as suggested by the *V. komodoensis* passage rates mentioned above, 2.12 prey items represent the normal stomach daily load.

Of all the males available for dissection, 64.13 per cent had food in their gut (stomach and intestines combined), with the range in number of prey items from 1 to 27 (Av. = 13.00, SD 7.49); and the total number of prey species in the gut of the same sex varied from 1 to 8 (Av. = 3, SD 5.33). Of the females available, 71.4 per cent had prey in the gut, with the number of prey items ranging from 1 to 17 (excluding those with ants, due to the large number of individual prey items represented per individual monitor in which ants occurred) (Av. = 5.29, SD 5.33), with the number of species per gut ranging from 1 to 3 (Av. = 2.29, SD 1.33). There is no significant difference between number of males and females with food in the gut, or in the number of prey species per gut. However, there is a significant difference in the means of the number of prey items in the gut of males and females (t test 2.61, df 48, $p = 0.25$), with males having a significantly greater number. Thus it appears

TABLE 1

NUMBER OF INDIVIDUAL PREY ITEMS EATEN BY JUVENILE *Varanus bengalensis*

	Lizard Sex				Percent of Total (no ants)
Prey Species	Males	Females	?	Total	
Coleoptera					
Tenebrionidae (*Gonocephalum*)	43	7		50	20.2
Carabidae	13	11		24	9.7
Elateridae	8	0		8	3.2
Staphylinidae	1	0		1	0.4
Cetonidae	1	6		7	2.8
Meloidae	2	0		2	0.8
Curculionidae	2	2		4	1.8
Scarabaeidae	5	1		6	2.4
(larvae)	2	1		3	1.2
Chrysomelidae (larvae)	1	0		1	0.4
Dermaptera	16	19	16	51	20.6
Hymenoptera					
Formicidae (*Campanotus*)	2	511		513	
Orthoptera					
Gryllidae	16	61	2	77	31.1
Nymphs	2	2		4	1.6
Gryllotalpidae (*Gryllotalpa*)	2	0	3	5	2.0
Acrididae (nymphs)	1	0		1	0.4
Arachnidae					
Scorpions	2	0		2	0.8
Centipedes (*Scolopendra*)	1	1		2	0.8
Totals	120	622		761	
excluding ants	118	111		248	100.0

that males and females probably hunt in equally diverse areas and capture an equally diverse number of prey species, but that males obtain a larger number of the same species than females do. This agrees with the behavioural data presented in Auffenberg (1979), showing that at least captive males of this species of monitor lizard eat more food and are generally more active than females of the same general size and age. Thus I suspect that in the wild, juvenile males of this species are probably also more active than females, travel further, or hunt more actively in the same amount of time.

Table 1 shows the prey species recorded in the guts, the total prey individuals of each in the total sample, the number of individuals per predator sex, and the per cent of the total. We found a total of 761 individual prey items, of which ants were the most numerous, and all were the same species—*Campanotus compressus.* The 513 ants recorded were found in five monitors, and in these the greatest proportion was found in two females (270, 240, and 1 per three females possessing ants, 1 ant was found in each of two males). Although the females may eat ants more commonly than males, it is clear that ants are often taken in large numbers at the same time. The fact that both soldiers and workers occurred in the samples suggests that nests of these ants were uncovered. Mertens (1942) speculated that the tongue may be used to transfer small food particles to the mouth. This is substantiated by observations made by the senior author of captive monitor lizards of the same species, which frequently feed on carpenter ants by licking them up individually.

Prey of the family Gryllidae were common in terms of number of individuals preyed upon. Both nymphs and adults were eaten, though the latter make up most (80%) of the total crickets taken.

Excluding ants, tenebrionids were the most commonly eaten. The differences between these and both dermapterans and gryllids are probably not significant. The overall number of prey items in the gut (to 270 if ants are included) was 1 to 54. The remaining prey items represent a second prey category of

TABLE 2

AVERAGE DRY WEIGHT OF MAJOR PREY SPECIES OF JUVENILE *Varanus bengalensis*

Prey species	Av. dry w. (g) (n=5)	wt	Number Eaten, range	(Av.)	Total wt (g), range	(Av.)
Coleoptera						
Tenebrionidae	0.67	0.54	1–24	(9.0)	0.67–16.12	(6.04)
Curculionidae	0.19	0.16	2	(2.0)	2	(0.38)
Carabidae	1.21	0.97	1–4	(2.18)	1.21–4.84	(2.64)
Scarabaeidae	1.82	1.46	1–4	(2.0)	1.82–7.28	(3.64)
Dermaptera	0.46	0.37	3–16	(7.29)	1.38–7.39	(3.36)
Scorpions	9.96	7.98	2	(2.0)	19.91	(19.91)
Gryllidae	0.47	0.38	1–54	(8.3)	0.47–25.4	(3.9)
Gryllotalpidae	2.08	1.67	2–3	(2.5)	4.16–6.24	(5.2)

much less common prey species (1-4 per gut).

Size of Prey.—Table 2 lists the most common prey species taken, the average dry weights of individuals in each prey category, the average number eaten when preyed upon, and the overall range and average total dry weight of each of the prey species found in each monitor. These data show that (excluding ants) the dry weights of individuals of common prey species taken by juvenile varanids vary from 0.19 to 9.95 g (curculionids to scorpions), representing an overall weight increase of 523 per cent from the smallest to the largest prey. The mean individual prey weight is 2.11 g, and the overall range in prey-to-predator weight is 0.16 to 7.98 per cent (Av. = 1.69%). The mean total weight of each prey species expected in the gut varies from 0.38 (curculionids) to 19.21 g (scorpions), with a mean of 4.88 g, or 3.91 per cent of the total average predator weight.

The largest prey are scorpions, though they are not often eaten. Gryllidae and Tenebrionidae are probably the most important prey taken in terms of their size and number.

Prey Habitat.—Table 3 shows that of the 10 most common prey categories, most (60%) are found in and under decaying vegetation debris, and one moves back and forth through shallow burrows in the soil. Thus, 70 per cent of the prey categories are represented by secretive species, all of which can be obtained at or near the surface. Observations on captive

TABLE 3

GENERAL HABITAT AND FOOD OF INSECT PREY OF *Varanus bengalensis.**

Prey Species	In or under (+) decaying vegetation debris	Injurious (+) or not (–) to crops
Coleoptera		
Tenebrionidae	+	++
Carabidae	+ – (varies)	+ –
Scarabaeidae	+ –	+ –
Curculionidae	– (on leaves)	+
Elateridae	+	–
Meloidae	– (active on surface)	+
Chrysomelidae	– (on leaves)	+
Dermaptera	+ (active nocturnally)	–
Orthoptera		
Gryllidae	+ (active nocturnally)	+
Gryllotalpidae	underground, secretive	+

* After Lutz, 1948.

V. bengalensis make it clear that the most prey are obtained by rooting through surface debris with the snout, or by scratching through it with the front feet. The habit of using the snout so extensively in prey-seeking may be an explanation for the posterior position and slit-like narial opening in this and certain other monitor species. Only 2 of the 10 prey categories (both are beetle families) are not found near or on the soil surface, but on leaves.

The same table also shows that almost all prey categories are injurious to agricultural crops. Dryden (1965) came to the same conclusion regarding the prey of *Varanus indicus* on Guam.

Vegetation as Food.—Though both Parry (1932) and Sharma and Vazirani (1977) implied that *Varanus bengalensis* occasionally feeds on vegetation on the basis of stomach contents, there is no behavioural data that they do so. While eating animal prey that is either dead or alive, vegetal debris is regularly ingested accidentally and this apparently accounts for the vegetation sometimes found in the stomach. However, *Varanus grayi,* an arboreal species from the Philippines, regularly feeds on several types of fruits (Auffenberg 1979), and *Varanus prasinus,* another arboreal species. from New Guinea, has also been reported to occasionally feed on bananas in captivity (Mertens 1942). Other than these two species, no other members of the family Varanidae are known to deliberately feed on any vegetation.

DISCUSSION

The data presented above show that juvenile *Varanus bengalensis* are probably completely insectivorous. This agrees with the data presented by Sharma and Vazirani (1977), for a very small sample of the same species from the same general part of India, and taken in the same part of the year. Additionally, in both studies the Order Coleoptera makes up most of the diet, with tenebrionids the major beetle group represented. Sharma and Vazirani (1977) also reported that termites are occasionally taken. This largely insectivorous feeding habit of juvenile *V. bengalensis* provides a rather low prey to predator weight ratio (.0169:1). While no accurate comparable data are available for adult Bengal monitor prey weight preferences, Minton (1966) listed proportionately larger prey in five adults from West Pakistan. Thus large individuals can be expected to have a larger prey to predator weight ratio. The same trend has been demonstrated in *Varanus komodoensis* (Auffenberg 1981), in which the largest adults, who often attack and kill deer, some weighing up to 204 kg (=prey to predator wt. 365:1), or even water buffalo up to 340 kg (=ratio of 608:1). These predator-to-prey ratios are probably the highest of any lizard species. However, the ratio for juvenile *V. komodoensis* (.0208:1) is approximately the same as in the present sample of *V. bengalensis,* though somewhat higher because juvenile Komodo monitors also feed on small lizards.

Though literature data are scanty and rarely comparable, I conclude that varanids may generally exhibit a higher predator-prey ratio than other lizards, for, in additon to *V. komodoensis* (Auffenberg 1978, 1981), proportionately large prey are also eaten by several other varanid species (Dryden 1965, Pianka 1968, 1970, 1971).

The data presented above, plus general experience, suggest that there are relationships existing between the mass of reptile predators and their prey that have not yet been brought to light by previous studies of reptilian food habits. These relationships may change from juveniles to adults in some species, and show no change in others. Considerable differences in these relationships are expected between various reptilian groups. They probably constitute one of the most important factors in feeding behaviour and functional morphology of feeding mechanisms.

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COURTSHIP AND COPULATION IN *MYLLOCERUS UNDECIMPUSTULATUS MACULOSUS* DESB. (COLEOPTERA: CURCULIONIDAE)[1]

K. Thangavelu[2]

(*With two plates containing seven figures*)

INTRODUCTION

Several aspects of the ethology of reproduction in Coleoptera are well documented in the families Buprestidae (Alcock 1976), Carabidae (Lorochelle 1973), Cicindelidae (Master 1976), Coccinellidae (Wang *et al.* 1977), Dermestidae (Barak and Burkholder 1977, Chaudhary and Kapil 1976 and Hammack *et al.* 1976), Hydrophilidae (Scheloske 1974), Lucanidae (Mathieu 1969), Meloidae (Selander 1964, Selander and Pinto 1967, Pinto 1972, 1974, 1975, 1977a and 1977b); Scarabaeidae (Bennett 1974, Halffter and Yrma 1977, Hardy 1976) and Staphylinidae (Peschke 1978). Though the family Curculionidae is a very large one and several species are economically important reproductive behaviour is known only in a few species, *Hylobius abietis* (Selander and Jansson 1977), *Microlarinus laervnii* (Kirkland and Geoden 1978) and *Anthonomus grandis* (Villavaso *et al.* 1975). Therefore an attempt, though preliminary in nature is made on the ethology of reproduction in the ash-weevil, *Myllocerus undecimpustulatus maculosus* Desb, which is Oriental in distribution. It is a polyphagous species and a serious pest on Cotton (*Gossypium barbadense* and *G. hirsutum*), Brinjal (*Solanum melongena*) and other crops in India. The previous works on *M. maculosus* pertain to control measures (Krishan Kumar and Rattan Lal 1966); recording the host plants (Bhutani 1975) and unusual occurrence (Kareem *et al.* 1977) etc. are of preliminary nature only.

MATERIAL AND METHODS

Late instar grubs and pupae were brought from the fields and reared on cotton root in petri dishes. Newly emerged adults were released in pairs in glass jars to observe their courtship and mating. Fresh cotton leaves were provided as food for the adults. To avoid possible behavioural variability due to "learned" sexual behaviour, studies on courtship were performed on virgin adults.

The following different combinations of male and female were maintained separately to study the reaction of the adults in various mating types that exist under natural condition. (1) Newly emerged males and females, (2) Newly emerged males and unmated females of different ages (5-10 days after eclosion), (3) Newly emerged males and previously mated females, (4) Newly emerged females with previously unmated males, (5-10 days after eclosion), (5) Newly emerged females with previously mated males, (6) A few males along with more number of females, (7) Several males along with less number of females. The laboratory observations were compared with obser-

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vations made in the field during September 1976 to December 1978.

Set up 1 shows the normal mating behaviour.

Set up 2 to 5 show the effect of age on mating response.

Set up 6 and 7 show the mating competition and aggression when one sex is predominent in a colony.

OBSERVATIONS AND RESULTS

Normal mating (Mating type 1):

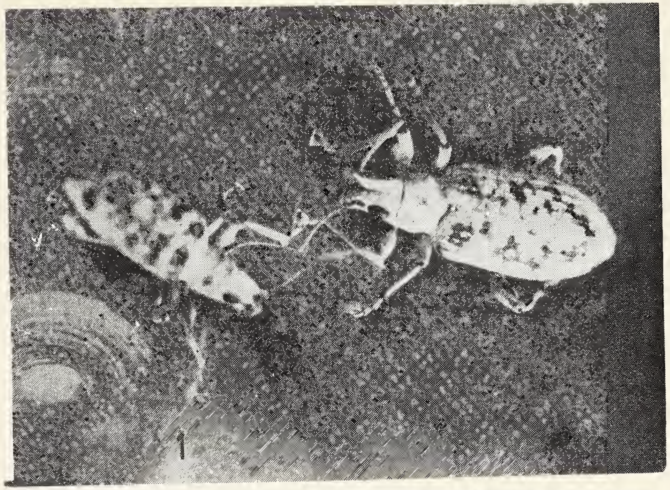
Adults start mating 2-3 days after eclosion. When the male encounters the female, it instantaneously strikes the antennae of the female with its own antennae (Fig. 1). A receptive female remains motionless while an unreceptive female escapes with jerky movements. The male advances its fore legs and rubs the fore tarsi of the receptive female (Fig. 2) and the responding female reciprocates with a few antennal strokes on the attempting male. Then the male moves to the side of the female (Fig. 3) and with its fore legs rubs the pronotum of the female. This tactile stimulus rouses the female to raise the tip of its abdomen after disengaging the pygidium. Meanwhile, the male having released its aedeagus finds no resistance to establish genital connection (Fig. 4). The entire courtship does not extend beyond two minutes. Among virgin males and females the antennation and fore tarsal stimulation continues for 5-10 seconds. Once genital connection is achieved the male remains docile throughout and keep its antennae either straight or bent midway. The female, on the other hand, moves about dragging the male to suitable secluded places. Both males and females do not feed during copulation. When undisturbed the copulation lasts for 5-7 hours. Mating is quite common during early hours of the morning (05.00 hrs to 09.00 hrs). After copulation the male and female move away and occasionally the males continue to pester by dorsal riding (Fig. 5). The various sequences involved in the courtship and copulation are shown diagrammatically in Fig. 7.

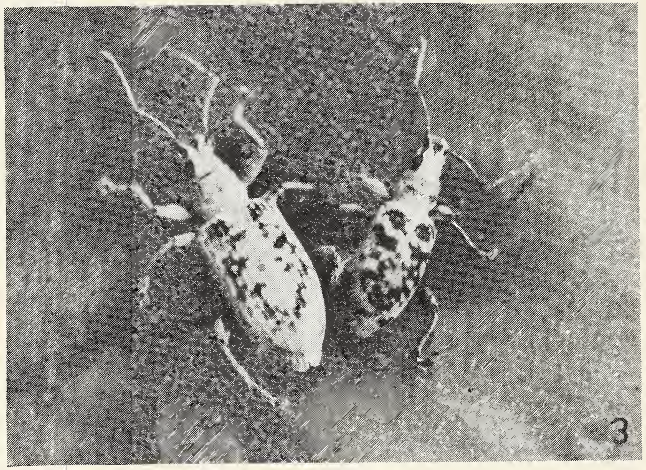
Effect of age on mating response

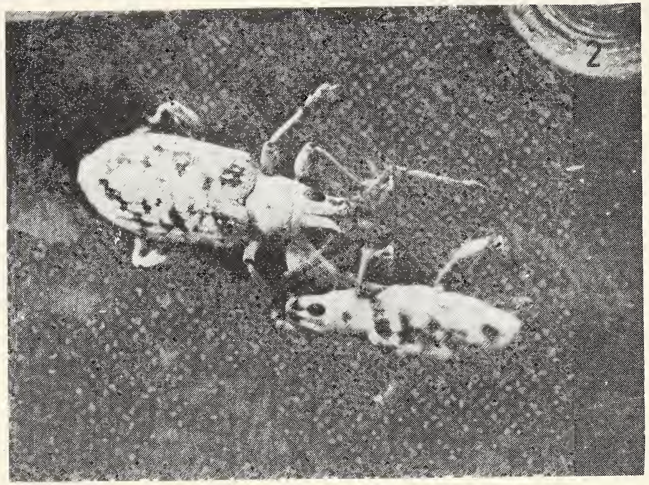
(Mating type 2):

Though the females are sexually active, they never initiate mating behaviour. Newly emerged males and virgin females behave in a similar fashion as described above, the females readily responding to the mating attempts initiated by the males. (Mating type 3): When newly emerged males are released among already mated females, the latter do not readily respond and, therefore, the pre-courtship behaviour is a bit more elaborate. Occasionally such females run away while the males persistently run after them and grab them with the fore legs and forcibly detain them by suddenly jumping upon them and lifting the posterior tip of the female's abdomen with their hind legs. An unreceptive female shakes off the male convulsively or only allows dorsal riding (Fig. 5) without separating the pygidium. But a virgin male persists in coaxing the female by gently drumming on the antennae and head of the female with its antennae, also frequently lifting the female's abdomen with its hind legs. When the female responds by straightening the abdominal segments and opening its genital aperture, the male secures genital connection while remaining on the dorsal side itself and releasing its aedeagus. Male releases its aedeagus only when the genital aperture of the female is opened and never in anticipation. This type of pre-courtship and dorsal riding by the male may last for more than 30 minutes. Occasionally, inspite of the coaxing of the male, the female remain unreceptive, dissection of such females show gravid

Thangavelu: *Myllocerus undecimpustulatus maculosus*







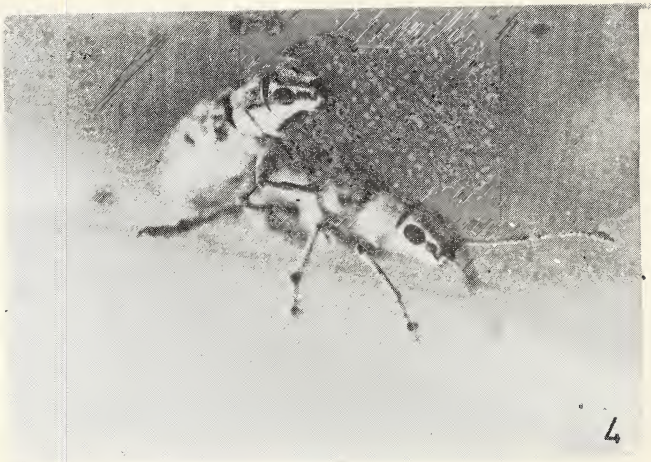
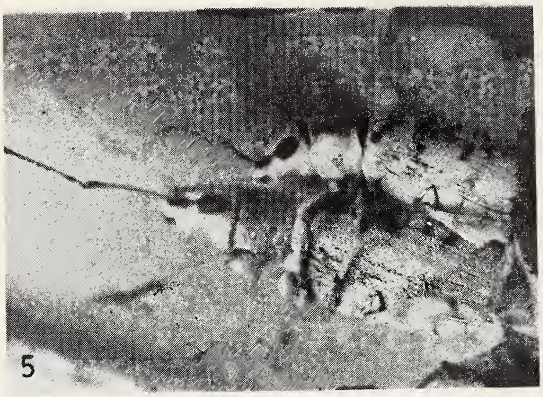
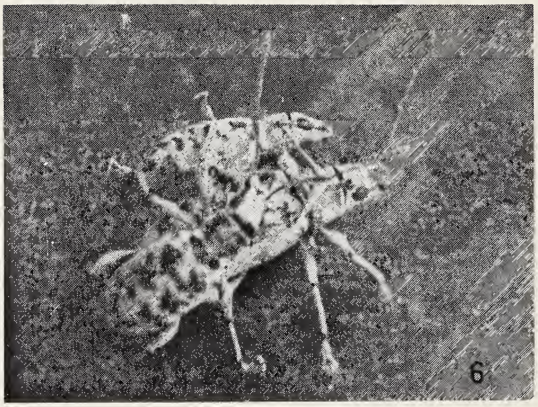


Fig. 1: Antennation. Fig. 2: Fore tarsi rubbing. Fig. 3: Male attaining lateral position to the female. Fig: 4: Copula position.

(Photos: *Author*)





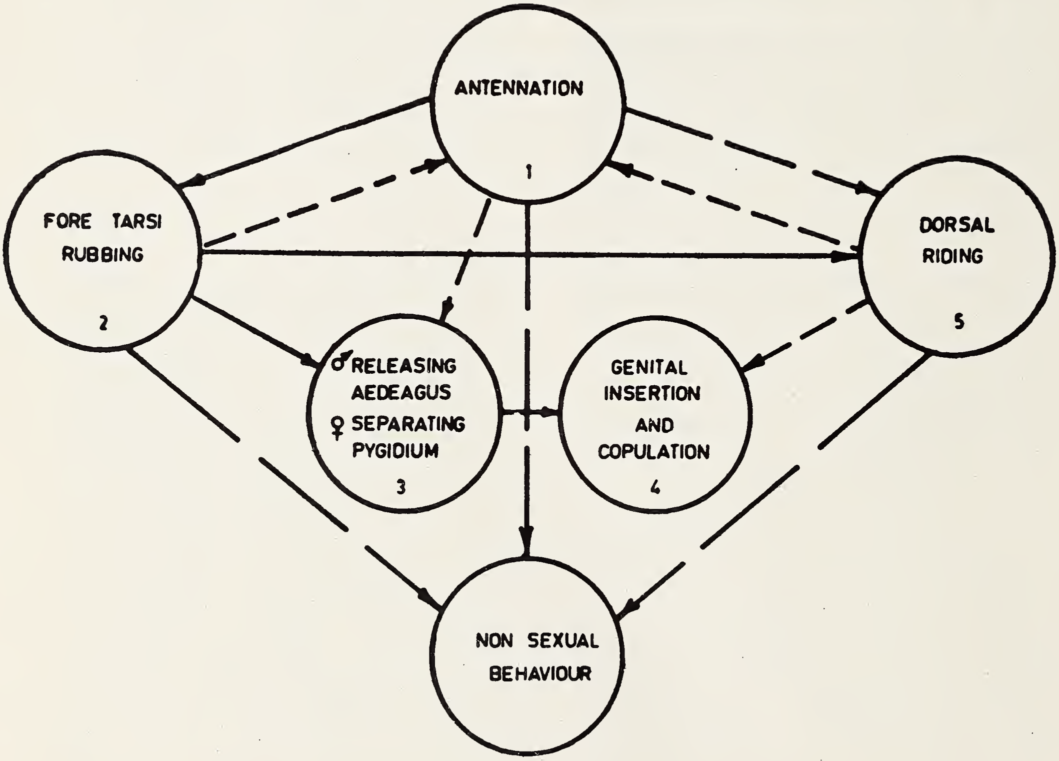

ANTENNATION
1
FORE TARSI RUBBING
2
DORSAL RIDING
5
♂ RELEASING AEDEAGUS
♀ SEPARATING PYGIDIUM
3
GENITAL INSERTION AND COPULATION
4
NON SEXUAL BEHAVIOUR

Fig. 5: Dorsal riding (without genital connection). Fig. 6: Intruding male attempting to sit in between copula pairs.

Fig. 7: Sequence diagram of mating in *M. maculosus*. *(Numbers within the circle refer to figure number)*

ovarioles with already matured eggs. (Mating type 4): When newly emerged females are paired with aged as well as virgin males the latter start antennation and fore tarsal rubbing, but the newly emerged females never show any receptivity, either they run away or allow dorsal riding by the males and final separation. Aged and virgin males remain excited and aggressive as indicated by the forcible lifting of the posterior tip of female's abdomen and pulling by his fore legs and violently stopping her from running away. Occasionally the males suddenly jump on the other male but separate quickly as the typical feminine response is not evoked by the male. (Mating type 5): When newly emerged females are placed along with previously mated males, the males are not aggressive and therefore the females move around the males. Mating is rarely attempted. In mating types 3, 4 and 5, frequency of successful mating is comparatively less (Table 1).

TABLE 1

EFFECT OF AGE ON MATING RESPONSE

Mating type	Number of copula pairs	Number of mating attempts	% of successful mating
1	10	35	86
2	15	50	80
3	15	43	50
4	15	45	55
5	10	30	33

Mating Competition and Aggression when one sex is predominent (Mating type 6):

When few males are placed along with several females, normal mating similar to mating type 1 is observed, the females without mates wander around and do not disturb the other pairs engaged in courtship and copulation. (Mating type 7): When males predominate in a colony of few females, the males without mates often disturb the copula pairs. Invariably the disturbing male persists by drumming on the mating female or rubbing the foretarsi of the female, but such female never responds. If the disturbance persists, then the female carries the male to a more isolated place. Occasionally the disturbing male is allowed to rest in between the mating pair (Fig. 6). In such cases the mating male raises its ventral side to accommodate the intruding male, the position of the mating male under such situation become almost perpendicular to the female. The intruder may thus rest for more than an hour — this type of unusual three in a mating position is also seen in the field frequently.

FIELD OBSERVATIONS

The ashweevil, *M. maculosus* lives and reproduces throughout the year in South India. They are abundant in the field during winter months, October to January. During this period mating is quite common. Newly emerged adults are sexually not active and require a maturation period. Hence mating is initiated only after 2-3 days of adult emergence. The males live 25-30 days while the females live for 30-45 days. During the entire adult period, females mate only 4-5 times, while the males mate more frequently. Receptivity in females decreases with age and previous mating attempts. The cool part of the day (05.00-09.00 hrs.) is preferred for mating in the field. In the laboratory conditions they mate throughout the day. Halffter and Yrma (op. cit.) recorded noon time to be the most favoured time for mating in *Phanaeus* (Scarabaeidae). During hotter times, the adults rest between the bracts and bolls or underneath the foliage.

DISCUSSION

Sexual identification is apparently visual. Morphologically the male and female look similar except for the size, the female is considerably larger than the male. Similarly vision plays the major role in the sex identification in *Pantorlytes szentivanyi* (Curculionidae) (Hassen 1975). The entire courtship is very brief and never lasts more than 2 minutes. Courtship is initiated by males only. When the male sights the female, he swings his antennae over the female. Similarly brief series of antennal contacts were recorded in *Microlarinus lareynii* (Curculionidae) (Kirkland and Goeden, op. cit.). Antennation detains the responding female, otherwise the unwilling female runs away swiftly. When the female stops, the male rubs with his fore legs the fore tarsi and pronotum of the female, which further stimulates the female. Engelmann (1970) refers this kind of tactile stimulus during courtship and mating in many species of Coleoptera. Apart from tacticle stimulation, Selander and Jansson (op. cit.) reported stridulation in males to be associated with the mating behaviour of the large pine weevil *Hylobius abietis.* Once the genital connection is secured the male rides on the female, fully supported by her body and remains motionless with his antennae erect or bent. This is the most dominant feature during mating in *M. maculosus* and Pinto (op. cit.) also records such behaviour in blister beetles of the subtribe Eupomphina (Meloidae). Whenever the intruder persists, the agitated male rubs the pronotum of the female with his fore legs, compelling the female to move to suitable isolated sites. While mating is in progress, the fore and mid legs of the male grip the lateral sides of the female's abdomen just over the mid and hind legs and the hind legs of the male hold the genital segments of the female. The tibiae, tarsi and claws of the fore and mid legs and tibial tips of the hind legs of the male are engaged in holding the female. The tarsi and claws of the hind legs of the male are kept bent and do not hold the female when at rest. Only when the female moves rapidly these organs are engaged in holding the venter of the abdominal tip of the female. In the mating position the female spreads all the three pairs of her legs on the resting surface. When copulation is intensive the foretarsi of the male are firmly placed on the elytra of the female and the male is almost vertical to the female. The percentage. of successful matings decrease when aged and previously mated adults were tested (Table 1). Fresh and unmated females are invariably receptive to mating, with 80% of successful mating (mating type 2 — Table 1). Only 50% of successful mating resulted with previously mated females (mating type 3). The percentage of successful mating is lowest (33%) when mated and aged males were tried with virgin females (mating type 5). Just mated females and those with fully matured eggs (confirmed by dissection of ovaries) never allow copulation. When the female is decidedly not receptive, the male does not persist in establishing genital connection but climbs over the female (Fig. 5) and sits for a considerably time and then lifts the genital segments in order to secure genital connection. However the male's aedeagus is only released when the female responds by opening the genital aperture. Unmated males, when coupled with newly emerged females, become sexually more excited when the newly emerged females do not respond to the repeated mating attempts of the males (mating types 2 and 6) indicating more sexual drive in the males than in the females. It also appears that the females do not become violent but the males become aggressive if denied an opportunity for mating.

Females never disturb other copula pairs while males do.

Summary:

Males and females of *Myllocerus maculosus* live and reproduce throughout the year, however sexual activity is more vigorous only during October-January. Mating in the field is quite common in the early hours of the day. Mating started only after 2-3 days of adult emergence. Sexual identification is mainly visual. Antennation and rubbing of fore tarsi and pronotum provides the mating stimulus for the female. The male only initiates courtship and thereafter remains docile, whereas female is very active during courtship and mating. Courtship is not elaborate, it lasts for two or three minutes only. Females mate only 4-5 times in their life. Gravid females do not mate. Males mate quite frequently. Mating efficiency decreases with age and previous mating in both sexes. Males disturb other copula pairs in crowded condition and, if denied a chance for mating, become aggressive. Males are sexually more vigorous than females.

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THE GENUS *LINDERNIA* ALL. (SCROPHULARIACEAE) IN INDIA[1]

V. V. SIVARAJAN & PHILIP MATHEW[2]

The Indo-Burmese species of the genus *Lindernia* All. have been revised by Mukherjee (1945). Since then, there have been considerable change in the circumscription and nomenclature of many of the taxa. The present paper is a taxonomic revision of the Indian species of the genus. In all, 22 species have been recognised, two of them, *L. mollugininoides* and *L. elata*, being new records for India. A new variety, *L. tenuifolia* var. *pygmaea* Sivarajan & Philip Mathew is recorded from Kerala. An artificial key for the species, their current nomenclature, and notes on their salient features, habitat and world distribution are provided.

The genus *Lindernia* All., as currently recognised, has about 100 species described under various generic names, viz. *Lindernia* All., *Vandellia* Linn., *Bonnaya* Link & Otto and *Ilysanthes* Rafin., circumscribed mainly on the basis of number of fertile stamens and nature of staminodes. However, generic alignments within this group has long been a matter of discussion and controversy. Linnaeus treated *Lindernia* and *Vandellia*, both with four perfect stamens, as two distinct genera (cf. Mukherjee 1945) though Bentham and many others preferred to unite them. *Ilysanthes* and *Bonnaya* are characterised by two perfect stamens and two staminodes but differ in their relative position. In *Ilysanthes*, the posterior pair is fertile and the anterior staminodal whereas in *Bonnaya* they are in the reverse order. Bentham (1835, 1846, 1876), J. D. Hooker (1884) and many others have preferred to keep them as distinct genera while others have united them under *Ilysanthes*. Blatter and Hallberg (1918) have pointed out the inadequacy of the staminal characters to circumscribe genera within this group but, have still opted not to disturb the then prevailing system of treating them under different generic names. Haines (1922) reduced the four genera into two but, in a different manner. He included *Bonnaya* in *Vandellia* and *Ilysanthes* in *Lindernia*, thus mixed up taxa with four and two perfect stamens. He recognised these groups mainly based on major vein configurations in their leaves, *Vandellia* with penninerved leaves and *Lindernia* with basally veined ones.

Neither staminal nor venation characters have provided adequate and reliable taxonomic criteria for circumscribing the different genera within this group. In fact, 'it would have been more appropriate for him (Haines) to go one step further and combine the four into a single genus' (Mukherjee 1945). This was however, done by Pennell (1935, 1943) who combined all these taxa under the single generic name *Lindernia*, a natural assemblage characterised by 'the remarkably uniform corolla, curiously recurving anterior filaments and by similar septicidal dehiscence of capsule'.

Indian species of this genus have been revised by Mukherjee (1945). He recognised 28

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species in all, from the Indo-Burmese region. Subsequent studies have however, altered the concept of species in this genus very drastically (Philcox 1964, 1968). Circumscription of several species have been expanded. For instances, *L. anagallis* (Burm. f.) Pennell, currently includes several taxa which were previously described under different binomials like *L. cordifolia* and *L. angustifolia. L. sessiliflora* is understood to be conspecific with *L. nummularifolia* and *L. laxa* with *L. pusilla.* Several species described by Blatter and Hallberg (1918) have been reduced to synonymy while one of them, *L. quinqueloba* (Blatt. & Hallb.) Mukherjee, which almost crosses the generic limits in the nature of corolla is no more considered to be a natural species (Saldanha 1963). Consequent to this change in the concept of species, several species recognised by earlier workers have been reduced to synonymy. The purpose of this paper is to bring the Indian species of this genus in line with the current concept of species in the genus. A study of the materials available in the various herbaria (mentioned at the end) have revealed that 22 species are available in India of which *L. elata* and *L. molluginoides* have hitherto not been known to occur here.

KEY TO THE SPECIES

1. Perfect stamens usually two:
  2. Capsules linear, much longer than the calyx:
    3. Lvs broadly ovate/elliptic:
      4. Lvs petioled . . .. *ruellioides*
      4. Lvs sessile or subsessile:
      5. Lvs aristate-dentate . . .. *ciliata*
      5. Lvs crenate-serrate . . .. *antipoda*
    3. Lvs linear/oblong:
      6. Lvs distinctly serrate . . .... *oppositifolia*
      6. Lvs shallowly toothed or subentire:
      7. Lamina 15 cm or more long .... *estaminodosa*
      7. Lamina not more than 4 cm long...... .... *tenuifolia*
  2. Capsules subglobose or ovoid:
  8. Capsules equalling the calyx:
    9. Lvs ovate/oblong . . .. *minima*
    9. Lvs orbicular/rounded . . . . *rotundifolia*
  8. Capsules longer than the calyx:
    10. Pedicels deflexed in fruit:
    11. Corolla twice as long as the calyx...... .... *parviflora*
    11. Corolla 3-4 times longer than calyx..... .... *hyssopioides*
    10. Pedicels not deflexed in fruit.......... .... *manilaliana*
1. Perfect stamens usually 4:
  12. Capsules equalling or shorter than calyx:
    13. Flowers in terminal racemes, also axillary, solitary:
    14. Calyx shortly toothed . . .. *crustacea*
    14. Calyx deeply divided:
    15. Plants hairy . . .. *viscosa*
    15. Plants glabrous . . .. *multiflora*
    13. Flowers never in terminal racemes, always axillary, solitary:
  16. Calyx shortly toothed:
    17. Plants glabrous . ... *molluginoides*
    17. Plants hairy . . .. *hookeri*
  16. Calyx divided to the base:
    18. Plants glabrous:
    19. Lvs pinnately veined . . .. *elata*
    19. Lvs basally veined . . .. *procumbens*
    18. Plants hairy:
    20. Lvs ovate/oblong, densely hairy on both sides . . .. *montana*
    20. Lvs ovate/orbicular, sparcely hairy..... .... *pusilla*
  12. Capsules much exceeding the calyx:
    21. Calyx shortly toothed at apex .... *nummularifolia*
    21. Calyx deeply divided . . .. *anagallis*

L. ruellioides (Colsm.) Pennell, Brittonia 2: 182. 1936 & J. Arn. Arb. 20: 81. 1939; Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945; Philcox, Kew Bull. 17: 484. 1964 & 22: 54. 1968. *Gratiola ruellioides* Colsm. Prod. Desc. Grat. 12. 1793. *Bonnaya reptans* (Roxb.) Spreng. Syst. 1: 41. 1824; Hook. f. Fl. Brit. Ind. 4: 284. 1884. *Ilysanthes reptans* (Roxb.) Urb. in Berl. Deutsch. Bot. Ges. 2: 436. 1884; Gamb. Fl. Madr. 962. 1923.

Stem usually creeping and rooting at nodes; leaves ovate/elliptic, obtuse; flowers lilac or purple; pedicels slender; capsules linear, acute, to 2 cm long.

In moist or swampy grasslands, cultivated fields and waste places, throughout tropical and subtropical Asia. In India Eastern Himalayas and W. ghats.

Selected specimens studied:

Deb 25817, 26005, Panigrahi 14692, 14890 (NEFA), Joseph 37410 (Nongpoh), Kanjilal 927 (Khasi & Jaintia Hills), 5370 (Garo Hills), Bor 21017 (Naga Hills), Sharma 9770, 16813, 13395 (Khasi & Jaintia Hills), Kanjilal 3377 (Lakhimpur), Sworoopanandan 381, 403 (Palghat), Calder & Ramaswami 374, Rama Rao 1501 (Kerala), Clarke 25171, King 4843 (Sikkim), Deb 27095 (Tripura), Clarke 45671, Hook. f. & Thoms. sn. 323542 (Meghalaya).

L. ciliata (Colsm.) Pennell, Brittonia 2 : 182. 1936 & J. Arn. Arb. 24: 253. 1943; Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945. *Gratiola ciliata* Colsm. Prod. Desc. Grat. 14. 1793. *Bonnaya brachiata* Link & Otto, Ic. Pl. Select. 25, t. 11. 1820; Hook f. Fl. Brit. Ind. 4: 284. 1884; Blatt. & Hallb, J. Bombay nat. Hist. Soc. 25: 418. 1918. *Ilysanthes serrata* (Roxb.) Urb. in Berl. Detsch. Bot. Ges. 2: 436. 1884; Gamble Fl. Madr. 962. 1923. *Vandellia brachiata* (Link & Otto) Haines, Bot. Bih. & Or. 632. 1922. *Lindernia bracteoides* (Blatt. & Hallb.) Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945.

Erect annuals; leaves elliptic-oblong, aristate-dentate; flowers bluish or pink, rarely white; pedicels upto 1 cm long; capsules linear, 1.5 cm long.

Very common in moist or wet lateritic slopes and grasslands during monsoon, in South and S. E. Asia and Australia. In India throughout.

Selected specimens examined:

Deka 20283 (Assam), Panigrahi sn. 16007 (Orissa), Blatter & Hallberg 1514 (type material of *Bonnaya bacteoides* from Mt. Abu. S. K. Mukherjee has noted on the sheet that the characters selected by the authors to distinguish this from *B. bracteata* do not hold good); A. S. Rao 47924 (NEFA); Sebastine 8761 (Rewa, M. P.), Panigrahi 13207 (Bilaspur), Arora 4706 (Allahabad); Reddi 99032 (Lonavla), Billore 113184 (Thana, Pune); Balakrishnan 11021 (Andhra); Sivarajan 283 (Calicut), Thomson sn. 323506 (Karnataka); Fischer 2248 (Coimbatore); Clarke 25128 (Sikkim).

L. antipoda (Linn.) Alston in Trimen Fl. Ceyl. 6. suppl. 214. 1931; Philcox, Kew Bull. 17: 484. 1964 & 22: 57. 1968. *Ruellia antipoda* Linn. Sp. Pl. 635. 1753. *Bonnaya grandiflora* (Retz.) Spreng. Syst. 1: 41. 1824. *B. veronicifolia* (Retz.) Spreng. Syst. 1: 41. 1824; Hook. f. Fl. Brit. Ind. 4: 285. 1884. *Ilysanthes veronicifolia* (Retz.) Urb. in Berl. Deutsch. Bot. Ges. 2: 436. 1884; Gamb. Fl. Madr. 962. 1923; *Lindernia veronicifolia* (Retz.) Haines, Bot. Bih. Or. 634. 1922, excl. *Vandellia augustifolia,* Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945. *L. anagallis* (Burm. f.) Pennell, var. *grandiflora* (Retz.) Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945.

Prostrate or diffuse herbs; leaves variable, serrate; flowers blue with yellow mouth, axillary, solitary and in terminal biparous racemes; fruiting pedicels spreading, 1.5 cm long; capsule twice as long as the calyx, 1-1.5 cm long.

Common in swamps, grasslands, waste places and also as a weed in cultivated fields. Tropical and subtropical Asia, from India eastwards. In India throughout.

Selected specimens examined:

Ellis 19984, Sivarajan 389, 1014 (Calicut), Sebastine 20826, Fischer 1814 (Palghat); Ramamurthy 25994 (Trichur), Fischer 4508, Hook. f. & Thomas. sn. 323584 (MH, Kerala); Sebastine 16547 (Kottayam); Rao 26764, Karthikeyan 26880, Rao 26880 (This sheet in MH contains two different elements, *L. antipoda* and *L. hyssopioides*), Deb 31296 (Salem); Subrammanyam 9379, 8290 (Madurai), Sharma 35822, Subba Rao 36146, Subramanyam 10392, (Nilgiris), Henry 45547 (Chingalpet), Shetty 32233, Vajravelu 38861 (Tinnevelly); Sebastine 2486, Chandrabose 31135 (Coimbatore); Bourne 149, Fischer 226, 817 (Tamilnadu); Meebold 10114 (Pondicherry); Subba Rao 32019 (Chittoor), 19720, Balakrishnan 10792 (Visakhapatanam); Panigrahi 13218 (Bilaspur, M. P.); A. S. Rao 39140 (Assam); Biswas 5159 (Tripura); Meebold 10114 (Pondicherry); Fischer 1814, 4508 (Kerala); Haines 575 (Bihar); Panigrahi 8475 (Orissa).

L. oppositifolia (Linn.) Mukherjee, J. Ind. Bot. Soc. 24: 134. 1945. *Gratiola oppositifolia* Linn. Sp. Pl. (Ed. Willd.) 1: 105. 1797. *Bonnaya oppositifolia* (Linn.) Spreng. Syst. 1: 41. 1824; Hook. f. Fl. Brit. Ind. 4: 286. 1884. *Vandellia oppositifolia* (Linn.) Haines, Bot. Bih. Or. 634. 1922. *Ilysanthes oppositifolia* (Linn.) Urb. in Berl. Deutsch. Bot. Ges. 2: 435. 1884; Gamble Fl. Madr. 962. 1923.

Erect, annuals; leaves oblong-obtuse, serrate; flowers blue in terminal racemes; capsules linear, much exceeding the calyx; pedicels deflexed in fruits, almost as long as the fruit.

Common weed in wet low lands and paddy fields, in India.

Selected specimens examined:

Ramamurthy 22720 (Ramnad), 17652 (N. Arcot), Joseph 3956, Sivrajan 317 (Calicut); Henry 45549 (Chingalpet); 2110 (Coimbatore); Reddi 97926 (Lonavla); Panigrahi 12584 (Mirzapur, U.P.); Hooper 39629 (Orissa); Fischer 2110 (Coimbatore); Thomson sn. 322701 (CAL).

L. estaminodosa (Blatt. & Hallb.) Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945. *Bonnaya estaminodosa* Blatter & Hallberg, J. Bombay nat. Hist. Soc. 25 :416 1918.

Erect, profusely branched annuals, 20-40 cm tall; leaves oblong to oblanceolate, entire or subentire; flowers in terminal racemes; staminodes absent; fruiting pedicels and capsules about four times as long as the calyx.

In wet low lands. This species is extremely rare and was collected from the back waters at Cherukunnu, Cannanore Dt. Distributed along the western peninsular India.

Specimens examined:

Sivarajan 518 (Cannanore), Talbot 1930, 1584 (Karnataka).

L. tenuifolia (Colsm.) Alston in Trim. Fl. Ceyl. 6. suppl. 214. 1931; Mukherjee, J. Ind. Bot. Soc. 24: 134. 1945; Philcox, Kew Bull. 22: 62. 1968. *Gratiola tenuifolia* Colsm. Prod. Desc. Grat. 8. 1793. *Bonnaya tenuifolia* (Colsm.) Spreng. Syst. 1: 42. 1842; Hook. f. Fl. Brit. Ind. 4: 286. 1884. *Ilysanthes tenuifolia* (Colsm.) Urb. in Berol. Deutsch. Bot. Ges. 2: 435. 1884; Gamb. Fl. Madr. 962. 1923. *Vandellia tenuifolia* (Colsm.) Haines, Bot. Bih. Or. 634. 1922.

Erect, or diffuse annuals, branches 5-8 cm long; leaves narrow, linear-oblong, upto 3 x 0.3 cm; flowers solitary axillary or leaf-opposed, 8 mm long; pedicels deflexed in fruit, 1.2 cm long; capsules linear, 8 mm long.

In wet lowlands and along backwaters in Malaysia, Indochina, Sri Lanka and India. In India, Bengal and S. India.

Specimens examined:

Meebold 12684 (Quilon), CAL (erroneously identified as *Bonnaya oppositifolia*); Sivarajan 517, Sivarajan & Suresh 21627 (Calicut). These specimens match well with the Koenig's material kept at Vahl's Herbarium at the University of Copenhagen (only photograph seen) based on which Colsmann described the species.

var. **pygmaea** Sivarajan & Philip Mathew, var. nov.

Haec varietas habitu multu diverso, pygmaea, foliis pseudo-acicularibus, floribus roseis et capsulis brevioribus habit ut in L. tenuifolia typica quae maior est et folia plana, flores caeruleos, capsula et pedicellos fructigeros longiores habet.

Erect, tufted herbs 3-5 cm long; leaves linear, apparently acicular, up to 2 cm long; flowers axillary or leaf-opposed, solitary, pale blue, much smaller than in the typical form; pedicels almost as long as the capsule, deflexed in fruit; capsules linear, 5 mm long.

Holotype Sivarajan 1368 (Kallai, Calicut) is deposited in the Central National Herbarium, Howrah and isotypes in the Calicut University Herbarium.

L. minima (Benth.) Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945. *Ilysanthes minima* Benth. in DC. Prodr. 10: 420. 1846; Hook. f. Fl. Brit. Ind. 4: 284. 1884; Gamb. Fl. Madr. 961. 1923.

Leaves only 2-3 pairs, entire, flowers yellow; pedicels capillary; capsules subglobose, equalling the fruiting calyx.

In wet or moist grounds, in S. India.

This species has been added on the authority of Mukherjee. We have not seen any material of this species from India.

L. rotundifolia (Linn.) Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945. *Gratiola rotundifolia* Linn. Mant. 274. 1767. *Ilysanthes rotundifolia* (Linn.) Benth. in DC. Prodr. 10: 420. 1846; Hook f. Fl. Brit. Ind. 4: 254. 1884; Gamb. Fl. Madr. 962. 1923.

Erect or diffuse herbs; leaves sessile, orbicular or ovate, entire or serrate; flowers white with purple blotches; capsules globose, equalling the fruiting calyx.

Common in wet or marshy lowlands, during monsoon, in S. India, Sri Lanka, Mauritius and Madagascar.

Selected specimens examined:

Vivekanandan 21347, 22993 (Kottayam), Sharma 41674 (Idukki), Sivarajan 433, 1343 (Calicut), Subramanyam 8220 (Madurai).

L. parviflora (Roxb.) Haines, Bot. Bih. Or. 645. 1922; Pennell, Acad. Nat. Soc. Phil. Mon. 5: 29. 1943; Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945. *Gratiola parviflora* Roxb. Cor. Pl. 3: 3, t. 204. 1811. *Ilysanthes parviflora* (Roxb.) Benth. Scroph. Ind. 34. 1835 & in DC. Prodr. 10: 419. 1846; Hook. f. Fl. Brit. Ind. 4: 283. 1884; Gamb. Fl. Madr. 961. 1923.

A variable species, branched or unbranched; leaves ovate-acute, sessile, 3-veined from base, entire; flowers axillary, solitary, white with purple blotches; pedicels long, deflexed in fruit; corolla variable in size, capsules ovoid or ellipsoid, almost twice as long as the calyx.

In wet low lands and cultivated fields during rainy season, in Trop. Africa, Indo-China and major part of India. The typical form of the species is branched from base, slightly suffruticose with well developed leaves and axillary, solitary flowers. Some of the specimens collected by the authors are delicate, sparcely branched, and fleshy with the upper leaves reduced to bracts giving the inflorescence an appearance of a raceme.

Selected specimens examined:

Sethi & Negi 25900 (Kottayam), Barnes sn. 106065 (Vandalur), Lawson 154 (Travancore), Fischer 1812 (Palghat), Sivarajan 1658, 21632 (Calicut); Subramanyam 5108 (W. Godavari), Sebastine 9767 (Nalconda), 8045 (Hyderabad), Chandrabose 29760 (Coimbatore), Ramamurthy 21036 (Ramnad), Vajravelu 34010 (Tinnevelly), 22443 (Salem), Talbot 864 (N. Canara), Sebastine 13926 (Jubbulpore), Panigrahi 16777 (Bilaspur), Rolla Rao 77744 (Bombay), Raizada 22768—with white flowers —(Gir, Saurashtra), Santapau 475 (Khandala), Clarke 26263, 26275, Hook. f. sn. 323428 (CAL) (W. Bengal); Gamble 8905, Clarke 34279 (Bihar) Fischer 836, 839 (Tamil Nadu), Lawson 154 (Travancore); Fischer 1812 (Dhoni).

L. hyssopioides (Linn.) Haines, Bot. Bih. Or. 635. 1922; Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945; Philcox, Kew Bull. 22: 50. 1968. *Gratiola hyssopioides* Linn. Mant. 174. 1767. *Ilysanthes hyssopioides* (Linn.) Benth. in DC. Prod. 10: 419. 1846; Hook. f. Fl. Brit. Ind. 4: 283. 1884; Gamb. Fl. Madr. 961. 1923.

Erect herbs, leaves variable in size and shape, basally veined, entire; flowers blue, axillary, solitary; pedicels very variable in length, deflexed in fruit; capsules ovoid, twice as long as the calyx.

Common in wet low lands in South and S. E. Asia. In India it is reported from South and also East Himalayas. It is difficult to differentiate this species and *L. parviflora* as has been mentioned by Santapau (1967). Both are variable and the range of variations often overlap. However, shape of leaves and relative size of the reproductive parts provide rather reliable diagnostic characters, to distinguish the two.

Selected specimens examined:

Vajravelu 27597, Joseph 17724 (Palghat), Rama Rao 1674, Ellis 18589, Sivarajan 47, 21632, 21633 (Calicut), Rama Rao 2187 (Quilon), Fischer 1811 (Palghat), Calder & Ramaswami 965 (Travancore), Balakrishnan 10210 (Coimbatore). Subramanyam 6591, 7524 (Salem), Ellis 34662, Subba Rao 36603 Nilgiri), Bourne 1132 (Pulney), Perottet 51 (Shevaroi Hills), Subba Rao 22579 (Visakhapatanam), Chandra Bose 45179 (Chittoor), Gamble 21807 (Visakhapatanam), Meebold 8237 (Karnataka), Balakrishnan sn. 83875 (S. Canara), Deka 19324 (Chirapunjee), Balakrishnan 47034, 47196 (Khasia & Jaintia Hills), Subramanyam 7182 (Bastar), Reddi 99079 (Poona).

L. manilaliana Sivarajan, Kew Bull. 31: 151-153. 1976.

Annual fleshy herbs, rooting at lower nodes, closely resembling the two preceeding species but can readily be identified by undivided staminodes, erect fruiting pedicels and unreduced upper leaves.

Reported from Calicut (Kerala), in wet swampy low lands.

Specimens examined:

Sivarajan 435 (Calicut), Sivarajan & Suresh 21629 (Calicut).

L. crustacea (Linn.) F. Muell. Syst. Cens. Austral. Pl. 1: 97. 1882; Mukherjee, J. Ind. Bot. Soc. 24: 130. 1945; Philcox, Kew Bull. 22: 17. 1968. *Capraria crustacea* Linn. Mant. 1: 87. 1767. *Vandellia crustacea* (Linn.) Benth. Scroph. Ind. 35. 1835 & in DC. Prod. 10: 413. 1846; Hook. f. Fl. Brit. Ind. 4: 279. 1884; Gamb. Fl. Madr. 959. 1923.

Erect or diffuse herbs, often purplish in colour; leaves ovate to elliptic, crenate-serrate or subentire; flowers pink, axillary, solitary and in terminal racemes; pedicels long; capsules equalling the calyx.

A variable species growing in almost all types of habitats, in South and S. East Asia, tropical Africa and America. In India throughout.

Selected specimens examined:

Rama Rao 1346 (Alleppy), Calder & Ramaswami 14 (Konni), Sivarajan 23, 322, 360, 1369 (Calicut), Thomson 316, Fischer 2075 (Nilgiri), Talbot 9, 469 (N. Canara), Raju 548 (Godavari), Balakrishnan 934 (Srikakulam); Cooke 64 (Mahabaleshwar), R. S. Rao 92497 (Maharashtra), Abraham 164 (Orissa), Clarke 34173 (Chota Nagpur); Prain sn. 322990 (CAL), Malick 265 (Purulia), Ghosh 2444 (Hoogly), Balakrishnan 39282, Panigrahi 11206 (Assam), R. S. Rao 8823 (Tripura), King sn. 322971 (CAL), Duthie 4247, 4249 (U.P.), Panigrahi 12958 (Bilaspur), Sebastine 8756 (Rewa), Ansari 63825 (Gujarat), R. S. Rao 19969 (NEFA).

Panigrahi 238354, 23867 and Janaki Ammal 9268 (CAL) labelled as *L. crustacea* are *Lobelia alsinoides* and Fischer 859 is *Torenia lindernioides*. It is observed that this species is usually confused with *L. nummularifolia* (Narayanaswamy 3359 CAL) and *L. pusilla* (T. A. Rao 8037 CAL, Panigrahi 21534, Deb 29162 (ASSAM), also besides the earlier mentioned species.

L. viscosa (Hornem.) Merr. Sp. Blanc. 14. 1918 & En. Philip. Pl. 3: 349. 1923; Philcox, Kew Bull. 22: 38. 1968. *Gratiola viscosa* Hornem. En. Pl. Hort. Hafn. 19: 1807; *Vandellia hirsuta* Benth. Scroph. Ind. 36. 1835; Gamb. Fl. Madr. 959. 1923; *Lindernia hirsuta* (Benth.) Wettst. in Engl. & Pr. Pfam. 4 (3b): 79. 1891; Mukherjee, J. Ind. Bot. Soc. 24: 131. 1945.

Erect or diffuse herbs, softly hairy throughout leaves ovate-oblong to obovate, obtuse, crenate-serrate; flowers white with a yellow mouth; capsules subglobose, almost as long as the fruiting calyx.

In moist, shady places, in Malaysia and Indian subcontinent. In India, along Himalayas and S. India.

Specimens examined:

Erady 2170, Sivarajan 343 (Calicut), Deka 21550 (K.&J. Hills), Bor 17246 (Aka Hills); Naithani 1953 (Dehra Dun), Nafday 32 (Nagpur), Sharma 515 (Calcutta).

L. multiflora (Roxb.) Mukherjee, J. Ind. Bot. Soc. 24: 131. 1945. Philcox. Kew Bull. 22: 36. 1968. *Torenia multiflora* Roxb. Fl. Ind. (ed. Carey 3: 96. 1832 *Vandellia multiflora* (Roxb.) G. Don, Gen. Syst. 4: 549. 1838; Hook. f. Fl. Brit. Ind. 4: 280. 1884.

Erect or diffuse, glabrous herbs with variable leaves; flowers in terminal racemes, short pedicelled; calyx deeply divided; capsules equalling the calyx.

In marshes and lowlands of Malaysia and India.

Specimens examined:

Mandal 9(?); Kurz sn. 323068, Chatterjee 729, Sen Gupta 72, Dutt 472 (W. Bengal); King 56, Banerjee 432 (Champaran, Bihar).

L. molluginoides (Benth.) Wettst. in Natur. Pflanzen. f. iv. 3b: 80. 1891. *Vandellia molluginoides* Benth. Scroph. Ind. 35. 1835.

Erect or diffuse herbs; leaves ovate-elliptic; flowers in apparent terminal racemes; pedicellate; calyx pubescent; capsules equalling the calyx.

This species can be distinguished from the related New Guinean species, *L. glabra* Philcox, by the pubescent calyx and much smaller flowers.

In wet or moist places in India and Burma.

Specimens examined:

We have come across only a single specimen of this species (Aroong 3661, CAL) from Orissa.

L. hookeri (Clarke *ex* Hook. f.) Wettst. in Natur. Pflanzen. f. iv. 3b: 79. 1891; Mukherjee, J. Ind. Bot. Soc. 24: 130. 1945. *Vandellia* *hookeri* Clarke *ex* Hook. f. Fl. Brit. Ind. 4: 280. 1884. *V. stemonoides* Haines, Bot. Bihar & Orissa, 661. 1922, *non* Miq.

Diffusely branched, hairy herbs; leaves ovate-oblong or lanceolate, hairy; flowers in terminal and axillary verticillate clusters; pedicels hairy; calyx hispid; strongly ribbed, cleft to the base.

In moist or wet places in Bihar, Bengal and N. E. Himalayas.

Specimens examined:

Meebold 6356 (Manipur); Clarke 40642, 40647 & sn. 323054 (CAL) and Clarke's illustration of the species. Panigrahi 16766 (NEFA) in the Shillong Herbarium of Botanical Survey of India labelled as *L. hookeri* is actually *Torenia thourasii.*

L. hookeri var. *kumaunensis* Pennell (Acad. Nat. Sci. Phil. Monogr. 5: 29. 1943) is recorded here on the authority of Pennell & Mukherjee (1945). The authors did not come across materials of this taxon in any of the Herbaria consulted.

L. elata (Benth.) Wettst. in Natur. Pflanzen. f. iv. 3b: 79. 1891; Mukherjee, J. Ind. Bot. Soc. 24: 131. 1945. *Vandellia elata* Benth. Scroph. Ind. 36. 1835 & in DC. Prodr. X: 414. 1846; Hook. f. Fl. Brit. Ind. 4: 280. 1884.

Slender, wiry herbs with short-petioled, ovate-acute, serrate leaves; flowers short pedicelled; calyx deeply divided, linear; capsules subglobose, as long as the calyx.

Andaman & Nicobar.

Specimens examined:

Mukherjee (l.c.) has recorded this species from Burma. This species is represented in the Calcutta Herbarium by a single specimen, Helfer 3908 from Andamans & Nicobar and hence included here.

L. procumbens (Krick.) Philcox, Taxon 14: 30. 1965 & Kew Bull. 22: 29. 1968. *Anagalloides procumbens* Krock. Fl. Siles 2: 398 t. 1790. *Lindernia pyxidaria* Linn. Mant. 2: 252. 177; Mukherjee, J. Ind. Bot. Soc. 24: 131. 1945, *nom. illeg. Vandellia erecta* Benth. Scroph. Ind. 36. 1835, in part; Hook. f. Fl. Brit. Ind. 4: 281. 1884.

Erect annuals; leaves sessile, ovate-obtuse; flowers white, long-pedicelled; capsules ellipsoid, 3-4 mm long.

In wet lowlands in South and S. E. Asia. In India throughout.

Specimens examined:

Meebold 10380, Arora 3747 & 3952 (?); Hooker J. D. sn. 32175, Anderson sn. 323174 (Sikkim); Verma 1976 (Rajasthan); Thomson sn. 323185 (Punjab); Kurz sn. 323176, Dutta 51, Prain sn. 323179 (W. Bengal); Clarke 31357 (Kashmir); Duthie 8362, 9626, 9630 (M.P.); Duthie 4248 (U.P.); Brekett 298 (Bihar).

L. montana (Blume) Koord. Exk. Fl. Java 3: 178. 1912; Philcox, Kew Bull. 22: 44. 1968. *Diceros montanus* Blume, Bijdr. 752. 1826. *Vandellia mollis* Benth. Scroph. Ind. 37. 1835; Hook. f. Fl. Brit. Ind. 4: 281. 1884. *Lindernia mollis* (Benth.) Wettst. in Natur. Pflanzen. f. iv. 3b: 79. 1891; Mukherjee, J. Ind. Bot. Soc. 24: 131. 1945.

Diffuse, profusely hairy herbs; leaves ovate to oblong, crenate-serrate, subsessile; flowers axillary, solitary or in few-flowered cymes; capsules shorter than calyx.

In marshy lowlands, in Indochina, Malaysia and India.

Specimens examined:

Bor 17244 (Aka Hills), 6480 (Naga Hills); Deka 23324 (K. & J. Hills), 16898 (Lakhimpur); Craib 182 (Haflong); Gammie 149, Watt 11728 (Assam); Hook. f. & Thoms. sn. 323158

(CAL) (Meghalaya); Panigrahi 14976, R. S. Rao 19976, 20084, Deb. 26644, 25870 (NEFA); Cousins 65, 167, Ripley 20. 47 (W. Bengal); Ribu 848, Watt 5717, King sn. 323148, Anderson 24816 (Sikkim).

L. pusilla (Willd.) Boldingh, Zakfl. Landbowstr. Java 165. 1916; Philcox Kew Bull. 22: 41. 1968. *Gratiola pusilla* Willd. Sp. Pl. 1: 105. 1797. *Vandellia scabra* Benth. Scroph. Ind. 36. 1835; Hook. f. Fl. Brit. Ind. 4: 414. 1884. *Lindernia hirta* (Cham. & Schlechtend.) Pennell, J. Arn. Arb. 24: 250. 1943; Mukherjee, J. Ind. Bot. Soc. 24: 131. 1945. *L. laxa* (Benth.) Mukherjee, J. Ind. Bot. Soc. 24: 1945. *Vandellia laxa* Benth. Scroph. Ind. 36. 1835; Blat. & Hallb. J. Bombay nat. Hist. Soc. 25: 416. 1918.

Prostrate or diffuse herbs rooting at nodes, hirsute all over; leaves ovate to orbicular, basally veined; flowers white with a yellow throat; distinctly pedicellate; capsules subglobose, less than the fruiting calyx.

In marshy lowlands, in South and S. E. Asia and S. Africa.

Specimens examined:

Fischer 4526 (Puttur), Meebold 8551 (S. Kanara), Calder & Ramaswamy 1618 (Travancore), Meebold 12153 (Cochin); Sivarajan 44, 436 (Calicut), Wight 2381 (?), Bennet 986 (Howrah), Saxena 1352, Panigrahi 23867 (Orissa), Clarke 26555 (W. Bengal), Prain sn. 323102 Banerjee 516 (Bihar), 4210 (Assam), Prain sn. 323107 (Nagaland), Ribu 3702 (Sikkim), Debbarman 742 (Tripura).

L. nummularifolia (D. Don) Wettst. in Natur. Pflanzen. f. iv. 3b: 79. 1891; Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945; Saldanha & Nicolson, Fl. Hassan Dt. 522. 1976. *Vandellia nummularifolia* D. Don. Prodr. Fl. Nep. 86. 1825; Hook. f. Fl. Brit. Ind. 4: 282. 1884; *V. sessiliflora* Benth. Scroph. Ind. 37: 1835; Hook. f. Fl. Brit. Ind. 4: 282. 1884; *Lindernia sessiliflora* (Benth.) Wettst. in Natur. Pflanzen. f. iv. 3b. 79. 1891; Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945; Philcox, Kew Bull. 22: 10. 1968.

Erect annuals, 4-5 cm tall; leaves sessile, ovate, serrate; flowers sessile or pedicellate; capsules ellipsoid, much longer than the fruiting calyx.

In shaded grasslands in Malaysia, India and Burma.

Specimens examined:

Vajravelu 41889, Sharma 35901 (Nilgiri); Barner sn. 131561 (Gudalur), Meebold 10113, 11537, Fischer 174, Clarke sn. 323219, 40053 (Tamil Nadu), Sexton 1264 (Maharashtra), Mukherjee 3894 (Bihar), Kinghorn 3, Gamble 3454 (W. Bengal), Johnson sn. 323199, King sn. 323201, Gill 117, Gupta 1546, Hooper 38962, Gamble 15091, Duthie sn. 323234 (CAL), Meebold 2826 (U.P.); Clarke 23712 (Himachal), 40053, Balakrishnan 658 (Assam), Clarke 40957, Prain sn. 323216 (CAL) (Nagaland), Panigrahi 14739, R. S. Rao 16451 (NEFA); Kurz sn. 323205 (CAL), Thomson sn. 323234 (CAL) (Sikkim).

L. anagallis (Burm. f.) Pennell, J. Arn. Arb. 24: 252. 1943; Mukherjee, J. Ind. Bot. Soc. 24: 133. 1945; Philcox, Kew Bull. 17: 484. 1964 & Kew Bull. 22: 45. 1968. *Ruellia anagallis* Burm. f. Fl. Ind. 135. 1768. *Vandellia pedunculata* Benth. Scroph. Ind. 37. 1835 & DC. Prodr. 10: 416. 1846; Hook. f. Fl. Brit. Ind. 4: 282. 1884. *V. angustifolia* Benth. Scroph. Ind. 37. 1835 & DC. Prodr. 10: 417. 1846; Hook. f. Fl. Brit. Ind. 4: 282 1884; *V. cordifolia* (Colsm.) G. Don, Gen. Syst. 4: 549. 1838; Haines, Bot. Bihar & Orissa 633. 1922. *Lindernia angustifolia* (Benth.) Wettst. in Natur. Pflanzen. f. iv. 3b: 79. 1891; Mukherjee, J. Ind. Bot. Soc.

24: 132. 1945. *L. cordifolia* (Colsm.) Merr. En. Born. Pl. 524. 1921 & En. Philip. Pl. 3: 437. 1923; Mukherjee, J. Ind. Bot. Soc. 24: 132. 1945.

Prostrate or diffuse annuals rooting at lower nodes; leaves very variable, ovate to linear-lanceolate, crenate-serrate to sub-entire; flowers white or pink axillary, solitary or in terminal racemes; capsules linear.

Specimens examined:

Sethi & Negi 25831 (Kerala), Sivarajan 1664, 1665 (Calicut), Rama Rao 2188 (Quilon), Ritchie 1134 (S. Concan), Wight 2380, Gamble? (CAL) (Tamil Nadu), Sebastine 3130 (Coimbatore), Rodriguez 2069 (Pulneys), Fischer 4551 (S. Canara), Dalzell sn. 323267 (CAL) (Maharashtra), Narayana Swamy 530 (Kota), Talbot 2129 (Orissa), (Of the 5 sheets of Panigrahi 8725 from Orissa (CAL) labelled as *Vandellia pedunculata* four belong to *Mecardonia procumbens*), Ribu 942 (Sikkim), Craib 542, King sn. 323251 (CAL), Clarke 37854 (Assam), R. S. Rao 1641, Debbarman 190, Biswas 4962 (NEFA), Thothathri 10002 (Bihar), Kurz sn. 323243, Mukherjee 5615 (W. Bengal), Panigrahi & Arora 8557 (Madhya Pradesh), Duthie 224 (Garwal).

In marshy lowlands in South and S. E. Asia. In India throughout.

Excluded species:

Ilysanthes capensis Benth. The single sheet (Meebold 10380, sn. 323467, CAL) from Tarikerem, Mysore(?) at an altitude of 2000 feet is labelled *Ilysanthes capensis* by Meebold who has also noted that it is a novelty to India. However, it seemed to us to be *L. parviflora*.

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SURVEY OF SOUTH INDIAN PELICANRIES[1]

V. NAGULU AND J. V. RAMANA RAO[2]

A survey was undertaken as part of a doctoral programme to assess the grey pelican (*Pelecanus philippensis* Gmelin, 1789) population and its distribution in the Indian subcontinent. As a first step we concentrated on known pelicanries in South India. Since the abandonment of the famous Kolleru Pelicanry (Neelakantan, 1946), Gee (1960), Guttikar (1974) and personal observation in 1980, a survey has become necessary to locate and census existing birds.

Keeping Nelapattu (Nagulu *et al,* 1980), Nagulu & Ramana Rao (1981), as a field station for continuous study of the 'Breeding and Feeding Biology of grey pelican or the spottedbilled pelican (*Pelicanus philippensis*), we visited the known Pelicanries during the breeding season on the dates mentioned against each

Location	*Date visited*
Vedanthangal Bird Sanctuary, Chengalpattu District, Tamil Nadu	12.12.1981
Telineelapuram, Srikakulam District, Andhra Pradesh	24.1.1982
Kokkare Bellur & Bannalli, Mandya District, Karnataka	4.7.1982
Kundakolam & Moondraidapu (not visited)	Personal communication with the village head 17.12.1981

Vedanthangal:

The grey pelican is an occasional visitor but not as a breeding bird to this ancient bird sanctuary. Grey Pelicans come here in flocks of 5-10 spend some time and depart (according to Forest Guard). We did not see any during our visit.

Telineelapuram:

A small hamlet of 40 to 60 houses in Srikakulam District, Andhra Pradesh, close to Tekkali off a by-pass road to Naupada on the east-coast. The village has Tamarind, Neem, Acacia and Prosopis trees. Of these, the tamarind and Neem are used by grey pelicans and painted storks (*Ibis leucocephalus*).

Though the Forest Department notified this pelicanry only in 1978, according to local people the pelicanry has been traditionally protected.

This village has a small tank which is practically dry and cannot store sufficient water as its bund is breached at more than one place.

During our visit we recorded 65 nests of pelicans on the 3 tall tamarind trees and in all about 65 young. The pelican population is around 200-250 birds including young. The young were in the age group of 30 to 45 days. As it was 11.00 in the morning the adult birds were returning from feeding. Pelicans regularly nest here during the months of October/November, every year without fail irrespective of climatic conditions. The Vamshadhara river, its estuary and Naupada swamp are the source of food.

The painted storks nested on 3 neem and 1 tamarind tree opposite to the pelicanry. About

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500-600 painted storks were counted. The young were in the age group of 30-45 days. The pelicans and painted storks visit about the same time (October/November). However, the arrival date requires personal confirmation as the painted storks arrive two months later than the pelicans in other places like Bellur, Karnataka, Edurupattu, Andhra Pradesh.

Kundakolam & Moondraidapu:

At the extreme south of Tirunelveli District, Kundakolam is a small interior village with 200-300 houses spread over 1 sq km in area. It has a very old Pelicanry first reported by C. E. Rheinus (1906). Since then it has been attracting grey pelican and painted storks every season but unfortunately this year the birds had not come for want of water as most of the tanks were dry due to paucity of rains (personal communication from village head and also news item in Hindu daily, Sunday Magazine, May 23, 1982).

In the same weekly edition, it was reported that the grey pelicans and painted storks have shifted to new refuge in Ariyakulam of Tirunelveli District.

Moondraidapu, a small village on national Highway No. 7, 20 km from Tirunelveli on the road to Nagercoil has 2 large tamarind trees which accommodates painted storks and grey pelicans every year but this year grey pelicans came and left without nesting while the few painted storks stayed throughout to rear their young. Here the colony has been established for the last 17 or 18 years. It is the youngest Pelicanry of those listed above.

In the new refuge at Ariyakulam the pelicans nest on a Banyan tree (*Ficus bengalensis*) and an "illuppai" tree (*Bassia latifolia*). The Tirunelveli District has several tanks and reservoirs, which satisfy the needs of the birds.

Kokkare Bellur & Bannalli:

These two adjoining villages in Mandya District, located 12 km from Rudrakshapuram on the Halgur Road, between Bangalore and Mysore is one of the oldest Pelicanries in India. It is probably the place visited by Jerdon (1864) a century ago, when he was told that the Pelicanry had been in existence for ages. Only recently Neginhal (1976) drew attention to it again. The villagers fear that the birds will get disturbed and may desert their village if undue disturbance follows publicity.

The village receives its name Kokkare as a prefix to Bellur because of the presence of the birds (Kokkare = Heron). Recently, we made a visit to the Pelicanry on hearing that the pelicas came there in the month of January/February for breeding. Unfortunately the pelicans were not sighted but we confirmed the arrival and departure timings of the pelicans. Though the pelicans were not seen, we had the chance of seeing the painted storks. There are about 22 trees big and small located in the dry-non-irrigated fields along the road side and in court yards. These were exclusively occupied by painted storks numbering 800 to 1000, each tree had on an average about 16 nests with either one or two young. None had three young. Almost all the young were flying.

The place is undisturbed and the young move under the trees in perfect harmony with cats and dogs in search of dropped fish. The Brahminy kites were present usually in large numbers with their immature young, and were seen scanning below the trees.

An interesting feature was that as the local people were engaged in transporting the scrapped guano in bullock-cart, the young birds moved around them as if tame and domesticated. But when we approached they took to flight and started soaring.

The following trees are used for nesting: *Ficus bengalensis* 4, *Ficus religiosa* 2, *Tamarindus indicus* 11, *Acacia arabica* 3 and an Avenue tree with yellow flowers 2.

We were told by the villagers that of these trees, only three were used by grey pelicans, two being Banyan trees located in the fields and a tamarind located in the middle of village. All the trees are reasonably tall about 30-40′ in height and it is very difficult to photograph a bird with 200 mm telephoto lens. We were told that about 12 grey pelicans still visit the village for roosting though majority of them left in the month of May.

The local people keep strict vigil on these birds, poachers and egg lifters are heavily fined. The bird excreta is rich manure and is scraped from the ground for use as manure in the fields. The landless however, sell the manure at Rs. 400/- per tree.

It was said that painted storks use tanks and irrigated fields as their foraging ground whereas pelicans exclusively feed in the tanks.

The whole Mandya District of Karnataka is well irrigated by tanks and rivers. Simsa a tributary of River Kaveri is barely half kilometre from the Pelicanry site, which again is a source of food for fish eating birds.

According to the local people about 100-150 pelicans breed in the village every year.

DISCUSSION

The spottedbilled or grey pelican (*Pelicanus philippensis* Gmelin 1789) frequents well watered tracts throughout the country and Pelicanries have existed in well watered tracts without increasing in numbers. It appears that the trees and water sources were same even before, no improvement has been made in the habitat of the areas. Probably this may be one of the reasons for maintaining the almost balanced number all through the years.

The southern states with their rich natural resources can provide a suitable habitat for such avifauna and attract increased numbers, especially where villagers themselves have recognised a mutualism and find that bird's presence helps in their rural economy.

As the birds are mostly fish dependent, its excreta contains high percentage of Phosphates and Nitrogen and is a very good substitute for chemical manures.

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We thank the Andhra Pradesh Forest Department; Mr T. Radhakrishnamurthy, Asstt. Director of Fisheries, Srikakulam; Mr A. N. Jagannatha Rao, Mr Menon of Range Rovers Foundation, Madras; Dr Victor of Bird Foundation, Bangalore; Mr K. S. Iyer, Photographer, Karnataka Forest Department, Bangalore, for their timely help during our Survey. A travel grant from the Sálim Ali-Loke Wan Tho Ornithological Research Fund of the Bombay Natural History Society is gratefully acknowledged.

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FIELD KEY OF *RANA ALTICOLA* ANNANDALE (ANURA : RANIDAE) TADPOLES[1]

A. K. SAHU AND M. K. KHARE[2]

(*With five text-figures*)

Rana alticola tadpoles are characterised by the presence of 2 clusters of parotid glands on the body, one ocellus on each side of the tail and marginal teeth rows in the oral disc with a large number of keratodonts having a formula 2:5+5/1+1:6.

INTRODUCTION

Rana alticola is one of the high altitude frog species found in the north eastern hill regions of India. Earlier reports on *Rana alticola* tadpoles by Annandale (1905 and 1912) and Smith (1924) are not adequate to identify and connect them to the species to which they belong. During the present investigation the tadpoles were reared and metamorphosed in the laboratory to the young froglet stage. The present description is based on at Gosner's (1960) stage 38 as per the criteria of Van Dijk (1966), which has been found to be most acceptable for the description of the tadpoles. It includes morphometric ratios also which are almost constant from species to species whereas the absolute measurements vary. The measurements given in the present description are mean of the samples collected ranging from smallest to the largest sizes.

Habitat and Habits: The tadpoles are generally found in the coves of mountain torrents, where they usually graze in large numbers on the stream bed. They are also found swimming up side down and filtering the plankton from the water. They occur in almost all months of the year in the mountains streams. Sometimes they turn out to be scavengers feeding on their dead relatives and other dead organisms.

DESCRIPTION

Body size and shape: Size 65.0-98.0 mm. Stream lined body, more or less ovoid and with a rounded snout. The tadpoles have two kidney shaped parotid glands on the dorsal side behind the eyes.

Mouth: The mouth is more or less subterminal in position with a round opening.

Oral disc: The oral disc is slightly emarginate. Lateral sides of the oral disc are somewhat expanded to form wing like structures. The width of the oral disc is 6.0-10.0 mm and that of the head at the level of the disc is 7.0-12.0 mm.

Oral Papillae: The marginal row of oral papillae is single. The margin is scalloped with a rostral gap (4.0-7.0 mm) and without a mental gap. Supra and infra-angular intramarginal oral papillae are arranged in rows.

Rostrodonts (Supra and infrarostrodonts): The suprarostrodont has lateral inflexions and serrated in the medial convex region. Serrations are longer (0.06 mm) than wide (0.04 mm),

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blunt and entirely keratinized. The infra-rostrodont is with medial inflexions, deeper than wide and serrated along with the entire margin. Serrations are longer (0.05 mm) than wide 0.035 mm) and entirely keratinized.

Keratodonts: Individual keratodont is compound, complex and longer (0.12 mm) than wide (0.05 mm). There are 2 uninterrupted and 5 interrupted rows of Supra 1 interrupted and 6 uninterrupted rows of infra-angular Keratodonts. The mental and aboral rows of Keratodonts are almost equal in length.

Keratodont formula: 2:5+5/1+1:6.

Nostrils: The nostrils are oval in shape and without raised rim. The nasal openings are visible from the anterior side which open antero-dorsally in the general body surface.

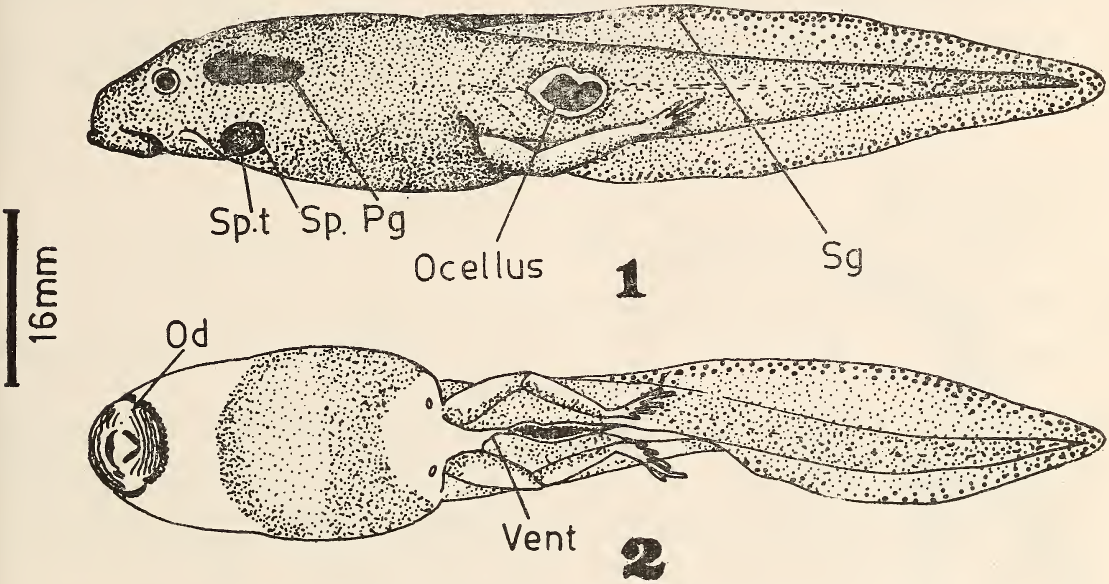


Fig. 1. Lateral view of a tadpole of *Rana alticola.*
Fig. 2. Ventral view of a tadpole of *Rana alticola.*
Abbreviations: Od, Oral disc; Pg, Parotid gland; Sg, Secretory glands; Sp, Spiracle; Sp.t, Spiracular tube.

Morphometric ratios:

1. Distance between nostrils $= \dfrac{\text{Internarial distance}}{\text{Nostril Width}} =$ 8.0-10.0 (Av. 8.6; SD 0.73)

2. Extranarial proportion $= \dfrac{\text{Head width-distance between lateral margins of nostrils}}{\text{Distance between lateral margins of nostrils}} =$ 2.0-2.8 (Av. 2.27; SD 0.28)

3. Longitudinal position of the nostrils in relation to the eyes.

$$= \frac{\text{Rostronasal distance}}{\text{Orbitonasal distance}} = 1.1\text{-}1.6 \text{ (Av. 1.38; SD 0.17)}$$

4. Eyes: The eyes are dorsolateral in position

Extraocular proportion

$$= \frac{\text{Head Width-distance between lateral margins of the eyes}}{\text{Distance between lateral margin of the eyes}} = 0.3\text{-}0.4 \text{ (Av. 0.35; SD 0.07)}$$

The orbitonasal line is visible as an unpigmented or slightly pigmented line. The pineal spot is visible as an unpigmented spot.

5. Spiracle: There is a single sinistral spiracle. The spiracular tube and the opening are visible from the dorsal side. The opening is raised constricted and opens posterodorsally.

Spiracular position anteroposteriorly

$$= \frac{\text{Rostrum to spiracle distance}}{\text{Rostrum to trunk distance}} =$$

a) Posterior displacement along the trunk = 0.53-0.6 (Av. 0.57; SD 0.01)
b) Posterior displacement along the tail = 0.19-0.26 (Av. 0.23; SD 0.01)

6. Vent: The vent is dextral, marginal and basicaudal with a folded aperture.

Vent ratio

$$= \frac{\text{Proctodocal tube length}}{\text{Vent Width}} = 1.6\text{-}2.0 \text{ (Av. 1.85; SD 0.18)}$$

7. Tail: The tip of the tail is rounded. Maximum height of the dorsal fin is at 40.0-59.0 mm from the snout and that of the ventral fin at 42.0-61.0 mm. The height of the tail is more or less equal to the height of the trunk. The fins originate in fleshy crests approximately near the base of the tail. The tadpole is euthyoural and the tail axis extrapolated forward passes through the ventral margin of the eye. There are some secretory glands near the margins of the tail fins and in the fleshy crest of the dorsal fin.

Tail length

$$= \frac{\text{Tail length}}{\text{Head length \& trunk length}} = 1.6\text{-}1.9 \text{ (Av. 1.68; SD 0.11)}$$

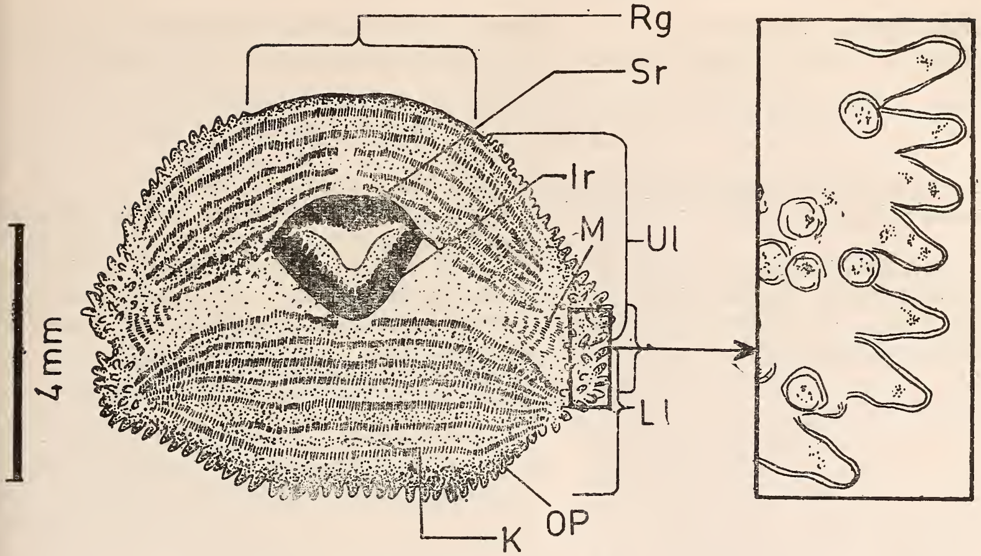
8. Trunk height

$$= \frac{\text{Tail height}}{\text{Trunk height}} = 1.0\text{-}1.2 \text{ (Av. 1.09; SD 0.08)}$$

Pigmentation: Some of the stream forms are yellowish while the pond forms are brownish in colour. The concentration of the melanophores is more near the margins of the tail fins. Pigmentation near the posterior margin of the eye is greater than the surrounding. Two large ocelli are present on either sides near the base of the tail.

DISCUSSION

The keratodont formula is one of the most important characteristics of the tadpoles for their species identification. Annandale (1912) reported that the keratodont formula of *Rana alticola* tadpoles was 2:5+5/1+1:8. In the present investigation we have invariably found it to be



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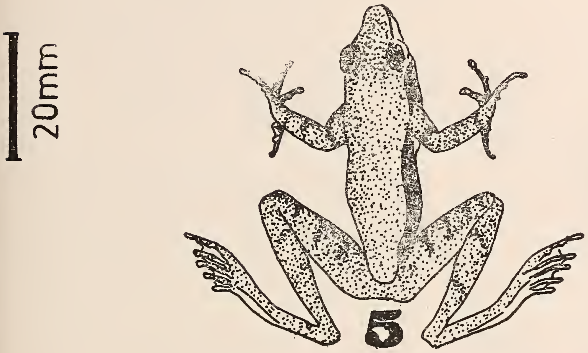

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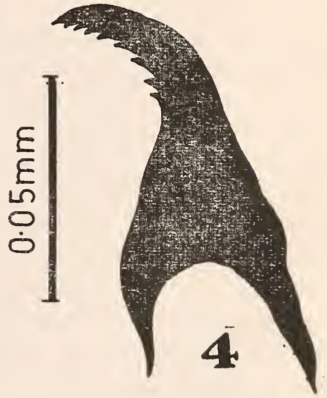

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Fig. 3. Oral disc of a tadpole of *Rana alticola.*
Fig. 4. Single keratodont of *Rana alticola.*
Fig. 5. Freshly metamorphosed young one of *Rana alticola.*
Abbreviations: Ir, Infrarostrodont; K, Keratodont; Ll, Lower lip; M, Marginal teeth; Op, Oral papillae; Rg, Rostral gap; Sr, Supra-restrodont; Ul, Upper lip.

2:5+5/1+1:6. He further reported that there were numerous large and small ocelli on the tail of the young tadpoles which gradually disappear with age and only one remained on each side of the tail of fully grown tadpoles. In the present investigation only one ocellus has been recorded on each side of the tail. The black spots on the fin membranes have been found to be secretory glands. Annandale recorded that the tadpoles grew at least up to 57 mm whereas in the present investigation they were found up to 98 mm in length which is comparable with the size (96 mm) reported by Smith (1924).

ACKNOWLEDGEMENTS

We are grateful to Prof. R. George Michael, Head of the Zoology Department for necessary facilities provided for this work.

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A CATALOGUE OF THE BIRDS IN THE COLLECTION OF BOMBAY NATURAL HISTORY SOCIETY — 27

MUSCICAPIDAE (Timaliinae) (*contd.*)

HUMAYUN ABDULALI

[*Continued from Vol. 79*(3): 619]

This part covers 459 specimens of 67 species and subspecies (Nos. 1272-1332 in INDIAN HANDBOOK together with 8 extra-limitals), the last specimen handled is Register No. 26290. Mr. Eric D'Cunha, Research Assistant helped with the work.

1272 **Garrulax cinereifrons** Blyth (Ceylon) Ashyheaded Laughing Thrush 1:196

1 o? (juv.) Petragalla, Balangoda, Ceylon.

Measurements on p. 159.

1273 **Garrulax albogularis whistleri** Baker (Simla) Western Whitethroated Laughing Thrush 1:154

26: 10♂♂ 12♀♀ 4 o? (1 juv.)

5 Simla, 4 Koti State; 1 Narkanda, 1 Mundali N. W. Himalayas, 1 Moundkhal, 1 Yorlinath, 1 Pothibassa, 5000′, Garhawal; 3 Ranibag, 1 Mornaula, 1 Binsar, 1 Pindari Glacier, 3 Dakuri, 1 Kumaon, 1 Mussoorie; 1 no data.

There is some local variation in the extent of rufous on the underparts and also the colour of the upperparts which do not appear as "a cline of increasing saturation towards the east", as stated in Vaurie (1959, p. 424). Nominate *albogularis, infra,* are more uniformly deeper in colour both above and below, and slightly smaller.

Measurements on p. 159.

1274 **Garrulax albogularis albogularis** (Gould) (Nepal) Eastern Whitethroated Laughing Thrush 1:153

12: 7♂♂ 5♀♀

1 Nagarcot, 1 Kakeni, Nepal; 1 Yigong Valley, Sikkim; 1 Gedu West, 1 Tongsa, 3 Tama, 2 Shamgong Central, 2 Wamrong East, Bhutan.

See remarks under 1273.

Measurements on p.

1275 **Garrulax moniliger moniliger** (Hodgson) (Nepal) Necklaced Laughing Thrush 1:151

7: 4♂♂ 2♀♀ 1 o?

1 Pershoke, 1 Poomong 2500′, Sikkim; 1 Samchi, West, 1 Mangdechu, Central, Bhutan; 1 Dening, Lohit Valley, 1 Miao, 1 Hornbill Camp, A.P.

The key in INDIAN HANDBOOK (7, p. 2) separates this species from *pectoralis* as having a tarsus under 40 mm. and wanting a black *chin* stripe. The tarsus, wing and bill are noticeably smaller, and the *chin* is a misprint for *cheek,* an error repeated on p. 6.

In addition to the size, all *pectoralis* have a large ear-patch with a varying amount of white and/or black, but which can generally be termed grey. Only a few grey feathers are visible in *moniliger.* Biswas in Birds of Nepal (*JBNHS* 59, p. 211) refers to subadults of nominate *pectoralis* having "rufous anterior to the pectoral band" but all such birds in our collection now are *moniliger,* the area being white in all *pectoralis.*

Measurements on p. 159.

1276 **Garrulax moniliger badius** Ripley (Tezu, Mishmi Hills) Mishmi Necklaced Laughing Thrush

10: 6♂♂ 4♀♀

1 Margherita, 1 Gujuri, Aka Hills, 1 Tezu, Lohit Valley, 2 Haflong, North Cachar, 1 Roopchena, 1 Cachar; 1 *Haibum*, 1 *Tawkmane, Chindwin;* 1 *s. e. of Maymyo, Kywizen, Henzada dist., Burma.*

This race said to be darker and more saturated with rufous is not very easily separable in the absence of topotypes or a more diagnostic description. Most of the above do have a rufous wash on the upperparts, though the 2 birds from the Chindwin River lack it and it is not quite clear if the distribution is restricted to the Mishmi Hills or how much further it extends into Cachar and Burma.

The species however can be easily separated from *pectoralis* by its smaller wing, bill and tarsus linked with the few grey feathers forming the earpatch detailed under 1275.

Measurements on p. 159.

1277 **Garrulax pectoralis pectoralis** (Gould) (Nepal) Nepal Blackgorgeted Laughing Thrush 1:150 (part)

nil.

1278 **Garrulax pectoralis melanotis** Blyth (Arracan) Assam Blackgorgeted Laughing Thrush 1:150 (part)

21: 11♂♂ 7♀♀ 3 o?

3 Rinchingpong, West, 1 Pershoke, Sikkim; 1 Samchi, West, Bhutan; 1 *Goalpara, 1 Dibrugarh, 2 Sadiya, 1 Lakeri, Assam; 2 *Haflong, North, 1 *Rupachena, Cachar; 1 *Kaira*, 1 *Pavtha, Lower Chindwin*, 1 **Kawaya*, *Chindwin*, 1 *Jade Mines*, 2 ***Maymyo*, 1* *Ruby Mines, Burma*; 1* no data.

There are no specimens from Nepal and *Garrulax waddelli* described from Ranjeet River, Sikkim, being synonymised with *melanotis*, it would appear that all the present specimens are *melanotis*, though none of them can be said to have all-black ear-coverts as required in the original description. There is considerable variation in the amount of chestnut on the upper and underparts, being almost absent below in some and leaving an almost all-white undersurface. This phase* cannot be associated with any specific age, season or area and among them No. 780 from Maymyo is marked as "a most unusually coloured specimen" by the collector J. P. Cook.

All the pale birds have the black coverts to their primaries tipped with grey, a character which appears in the others also.

Measurements on p. 159.

1279 **Garrulax striatus striatus** (Vigors) (Himalayas, restricted to Naini Tal) Western Striated Laughing Thrush 1:184

18: 8♂♂ 8♀♀ 2 o?

4 Simla, 2 Koti State; 8 Mornaula, 3 Dakuri, Almora, 1 Kumaon, U.P.

These have larger wings and tails than the other races.

Measurements on p. 159.

1280 **Garrulax striatus vibex** Ripley (Godavari, Central Valley, Nepal) Nepal Striated Laughing Thrush 1:184 (part)

4: 3♂♂ 1♀

2 Godavari, 2 Mayam, Nepal.

This is not very easily separable from the next form *sikkimensis*, though paler in series. Of the two from Mayam, the female No. 20350 was first separated as *sikkimensis* and also so marked by Biswas, but the other a male No. 20351, agrees with *vibex*. These and the next group have been subspecifically named largely on geographical grounds.

Measurements on p. 159.

1281 **Garrulax striatus sikkimensis** (Ticehurst) (Sikkim) Sikkim Striated Laughing Thrush 1:184 (part).

5: 2♂♂ 3♀♀

1 Nawrong, 1 Singhik, 1 Dikchu, Sikkim; 1 Darjeeling (purchased); 1 Crawford Market, Bombay (purchased).

Measurements on p. 159.

1282 **Garrulax striatus cranbrooki** (Kinnear) (Adung Valley, Burma) Assam Striated

Laughing Thrush 1:185

13: 2♂♂ 10♀♀ 1 o?

1 Tongsa, 1 Batase, Central Bhutan; 6 Narphong, 2 Wamrong, 1 Gomchu, 1 Rongtong, Eastern Bhutan; 1 Mishmi, Abor Country, Assam.

The "broad black stripe from eye to nape" is given as the key feature to separate this race from the others. A reference to the "dark edge of the bushy crest" would be more appropriate for the stripe disappears if the crest is brushed aside.

The two males from Central Bhutan lack this character, but are left here for they do not quite agree with *sikkimensis.*

Indian Handbook (7 p. footnote to p. 13) refers to 13 out of 14 *sikkimensis* obtained in Sikkim & Bhutan in different years being females. A similar anomaly is found under *cranbrooki* which is appreciably smaller, and has the head less streaked than the other 3 races.

Measurements on p. 160.

1283 **Garrulax leucolophus leucolophus** (Hardwicke) (Mts. above Hardwar) Himalayan White-crested Laughing Thrush 1:146 (part)

26: 14♂♂ 10♀♀ 2 o?

2 Kalka, 3 Simla; 1 near Gurnu, 1 Kumaon; 2 Hathiban, 1 Pathibajan 8000′, 2 Firping, Nepal; 2 Longview, Darjeeling; 2 Singtam, Teesta Valley, 1 Kurseong, 1 Sikkim, 1 Mangdechu, 1 Shamgong, 1 Khosala, Central Bhutan; 1 Dibrugarh, 2 Margherita, 1 Tezu, Lohit Valley, 1 Rotung, Mishmi Hills, Assam.

The three recent specimens from Bhutan (1967) lack the rufous on the hind neck present in all the others and so prominent in the five under *patkaicus* q.v.

Measurements on p. 160.

1284 **Garrulax leucolophus patkaicus** Reichenow (Patkai Range, Upper Burma) Assam White-crested Laughing Thrush 1:146 (part)

10: 8♂♂ 1♀ (imm.) 1 o?

2 Longkam, 1 Mehuri-Phek Rd., 59 m. east of Kohima, Naga Hills; 1 Leisung, 1 Haflong, N. Cachar; 1 Dimapur, Manipur; 1 *Mowlaik, Chindwin River; 2 Mindon Yomas, Thayetmyo; 1 Loikan, N. Shan States.*

These birds do not agree with the description of *patkaicus in* Indian Handbook, the first 3 from the Naga Hills as also the one from Mowlaik being very similar to nominate *leucolophus,* but which are kept apart for they are from south of the Patkai Hills.

Five more from further south have large rufous patches on the back of the neck. The sixth ♂ (727) also from Cachar, has the white of the breast running into the abdomen as in *belangeri,* but lacks the heavy rufous wash on the upperparts as in that form. It has a small wing and may well be a juvenile indicating its origin.

♂ 754 from Mowlaik, Chindwin River, was marked *hardwickii* at the American Museum of Natural History, but this name is synonymised with *patkaicus* in Indian Handbook.

Measurements on p. 160.

EL **Garrulax leucolophus belangeri** Lesson (Pegu Div., Lower Burma) Burmese White-crested Laughing Thrush 1:148

6: 1♂ 3♀♀ 2 o?

1 *Upper Burma;* 1 *Pankaung,* 1 *Prome Dist.;* 1 *S. Irawaddy;* 2 *Ataran, Tenasserim.*

These are distinguished by the heavy rufous wash on the upperparts and the white of the breast running further downwards.

Measurements on p. 160.

1285 **Garrulax chinensis nuchalis** Godwin-Austen (Khasi-Naga Hills, N. Bengal) Chestnut-backed Laughing Thrush 1:140

2♀♀ Margherita, Assam.

The type locality in Peters' *Checklist* (X p. 358) is said to be Lhota, Naga Hills, Assam.

Measurements on p. 160.

EL **Garrulax chinensis lochmius** Deignan (King Chian Saen, lat. 20°15′ N., long. 100° 05′ E.) Black-throated Laughing Thrush

4: 1♂ 1♀ 2 o? (1 imm.) N. Shan States.

All collected by J. P. Cook in Aug-Oct. 1913.

The racial idenitfication is based on the distribution in Peters' *Checklist* (X p. 359).

Immature (?) No. 714 is more rufous both above and below.

Measurements on p. 160.

1286 **Garrulax galbanus galbanus** Godwin-Austen (Manipur Valley, N. E. Bengal) Yellowthroated Laughing Thrush 1:107

1 ♀ Imphal area, Manipur (March 1946)

Wing 95 (♂♀ 92-96); bill 22.5 (20-22); tarsus 32.5 (*c.* 35); tail 98 (*c.* 105-110).

There is no trace of yellow on the underparts and no white supercilium which is replaced by thick black lines over the eyes meeting on the forehead and presenting the only black on the head.

1287 **Garrulax delesserti delesserti** (Jerdon) (Wynaad, S. India) Wynaad Laughing Thrush 1:149

5: 3♂♂ 2♀♀

1 N. Canara; 1 Wynaad, 1 Kottamalai, Cherambadi, Gudalur, Nilgiris; 1 Nelliampathy Hills; 1 Thattakad, N. Travancore.

Measurements on p. 160.

1288 **Garrulax delesserti gularis** (McClelland) (Assam) Yellow-breasted Laughing Thrush 1:152

5: 1♂ 4♀ (1 juv.).

1 Deothang, E. Bhutan; 2 Margherita; 1 Mugiva, Naga Hills; 1 Laisung, N. Cachar.

Though the yellow on the front is very prominent in the plate in Gould's BIRDS OF ASIA (1969) none of the specimens available, (the most recent being from Bhutan, 1966), show any trace of this colour. The text on the opposite page by A. Rutgers refers to the cheeks, throat and chin being white, though the next sentence says they are yellow'.

Measurements on p. 160.

1289 **Garrulax variegatus simile** (Hume) (Far Northwest — Gilgit) Western Variegated Laughing Thrush 1:174

8: 3♂♂ 4♀♀ 1 o?

1 Chitral, N.W.F.P.; 2 Murree, Rawalpindi; 1 Dachigaum, 1 Pijos Kishtwar, Kashmir; 1 Dalhousie, Gurdaspur, 1 Dharamsala, Kangra.

The specimens available are slightly smaller than of the next form.

Measurements on p. 161.

1290 **Garrulax variegatus variegatus** (Vigors) (Himalayas-Simla-Almora) Eastern Variegated Laughing Thrush 1:173

30: 20♂♂ 8♀♀ 2 o?

3 Summer Hill, 12 Simla; 3 Kheri, Koti State, 2 Fagoo, Keonthal State; 1 Kaliaghat, Ramni, Garhwal; 8 Dakuri, Kumaon; 1 Bodier?

This is another instance of the difficulty of identifying birds in which the colour fades and disappears rapidly. Jerdon (2 p. 45) refers to the outer webs of primaries being ashy white, tinged yellowish (probably bright yellow in the fresh bird), while Hume after separating *simile* for lacking the yellow even suggested (S. F. 3 p. 407) that his name may apply to what was described as *variegatus,* leaving the yellow tinged bird without a name. He later (S. F. 4:457) withdrew this suggestion for Gould had illustrated Vigors' type with yellow. Though the Old Fauna (1 p. 95) refers to the outer webs of the primaries and secondaries being bright golden yellow, a difference in colour is barely visible, the yellow now showing as a slightly stained effect *contra* a purer grey in *simile.*

Measurements on p. 161.

1291 **Garrulax cineraceus cineraceus** (Godwin-Austen) (Manipur Valley, N. E. Bengal) Ashy Laughing Thrush 1:156

2: 1♂ 1 o?

1 Phik, 54 m. east of Naga Hills, Assam; 1 *Chin Hills, Burma.* Wing 82, 85 (86-89), bill 21.4, 20.9 (*c.* 20), tarsus 29.2, 30.9 (*c.* 32), tail 92, 89 (*c.* 100).

Measurements on p. 161.

1292/3 **Garrulax rufogularis occidentalis** (Hartest) (Dehra Dun) Western Rufouschinned Laughing Thrush 1:159

8: 3♂♂ 3♀♀ 2 o?

2 Gama-ki-hatti 4500′, 1 Dharni State; 1 Bhagat State, 2 Simla Hills, 1 Simla; 1 Naini Tal, U.P.

1♂ (No. 812 Simla) and 1♀ No. 15889 Dharni State) have the tips of several rectrices projecting in hair-like strands 3-4 mm. long. Both have the black of the head broken up and together with the short (90 mm.) wing and the more rufous upperparts are no doubt juveniles. The curious character of the tail does not appear to have been noted.

Measurements on p. 161.

1294 **Garrulax rufogularis rufogularis** (Gould) (Sikkim) Rufouschinned Laughing Thrush 1:158

11: 6♂♂ 4♀♀ 1 o?

1 Rinchingpong, W. Sikkim; 2 Kurseong Div., Darjeeling; 1 Honka, W. Bhutan; 4 Tama, 1 Mangdechu, C. Bhutan; 1 Rongtong, E. Bhutan; 1 Buxa (Duars?), Assam.

These show more grey on the underparts than the last 1292/3. ♂ 21564 from Rinchingpong, Sikkim, has the underparts very faintly spotted. Three (2 Kurseong, Darjeeling, and 1 Honka, W. Bhutan) have pure white chins, the rufous chin being quite absent in one of the former No. 809, by measurements a juvenile.

Measurements on p. 161.

1295 **Garrulax rufogularis rufitinctus** (Koelz) (Pynursla, Khasia Hills) Khasi Rufouschinned Laughing Thrush 1:159 (part)

nil.

1295a **Garrulax rufogularis rufiberbis** (Koelz) (between Langyang and Htawgaw, Kachin State, Upper Burma) Burmese Rufouschinned Laughing Thrush

nil.

1296 **Garrulax rufogularis assamensis** (Hartert) (Margherita, Assam) Assam Rufouschinned Laughing Thrush 1:159 (part)

3: 2♂♂ 1♀ Margherita, Assam.

The upperparts and the vent are darker rufous than in nominate *rufogularis* and the rufous lores are distinctive.

Measurements on p. 161.

1297 **Garrulax ocellatus maximus** (Verreaux) (Mouping) Giant Laughing Thrush

nil.

1298 **Garrulax ocellatus griseicauda** Koelz (Wan, Garhwal, U.P.) Garhwal Whitespotted Laughing Thrush

4: 3♂♂ 1♀ Dukari, Kumaon, U.P.

In both wing and tail the rufous is more prominent than in *ocellatus.* The upperparts are paler and less heavily spotted.

Measurements on p. 161.

1299 **Garrulax ocellatus ocellatus** (Vigors) (Darjeeling) Whitespotted Laughing Thrush 1:155

5: 1♂ 3♀♀ 1 o?

2 Tongloo, Darjeeling, 1 Laching, N. Sikkim; 2 Chapecha, W. Bhutan.

See remarks under 1298. The spots are more triangular.

Measurements on p. 161.

1300 **Garrulax caerulatus caerulatus** (Hodgson) (Nepal) Himalayan Greysided Laughing Thrush 1:141

8: 3♂♂ 3♀♀ 2 o?

1 Rinchingpong. W. Sikkim; 1 Darjeeling (purchased); 1 Gedu, West Bhutan, 4 Wamrong, 1 Rongtong, East Bhutan.

The first two from Sikkim and Darjeeling have a pale yellow wash on the underparts and the earcoverts are less white and more inconspicuous than in those from Bhutan. ♂ No 24941 from Wamrong, East Bhutan, has traces of barring on the lower half of the upper surface of the central tail feathers.

Measurements on p. 162.

1301 **Garrulax caerulatus subcaerulatus** Hume (Shillong) Khasi Hills Greysided Laughing Thrush 1:142

nil.

1302 **Garrulax caerulatus livingstoni** Ripley (Mt. Japvo, Naga Hills, Assam).

nil.

EL **Garrulax caerulatus kaurensis** (Rippon) (Kauri-Kachin tract, to east of Bhamo, and bordering on the south of the Taping River) Nagaland Greysided Laughing Thrush 1:141 (part)

2 o?

1 *Loishong.* 1 *N. Shan States.*

These collected by H. Wood were acquired by the Society in 1907 and presumably subsequent to his paper on the birds of Paholkar Hills (1902, *JASB* 71, p. 121).

Peters' *Checklist* says it is only known from the type locality. It differs from the others available in having white tips to the tail and the white earcoverts much less pronounced.

Measurements on p. 162.

1303 **Garrulax ruficollis** (Jardine & Selby) (Sikkim) Rufousnecked Laughing Thrush 1:139

24: 6♂♂ 8♀♀ 10 o?

2 Rinchingpong, 1 Martam, Rongni Valley, Sikkim; 3 Longview Tea Estate, Darjeeling; 2 Samchi, West Bhutan, 1 Deothang, East Bhutan; 2 Sadiya, 1 Mishmi, Abor Country, 1 Miao, 1 Firm Base, A.P.; 1 Dibrugarh, 1 Roopachena, 1 Laising, N. Cachar; 1 *Debu, Chindwin River,* 3 *Upper Burma;* 1 *Hsipaw,* 2 *N. Shan States, Burma.*

There are some differences in colour, no doubt due to fading. A few of both sexes have faint barring on the upper surface of the tail feathers.

Measurements on p. 162.

1304 **Garrulax merulinus merulinus** Blyth (Cherapunji, Khasi Hills) Assam Spottedbreasted Laughing Thrush 1:186

nil.

1305 **Garrulax merulinus toxostiminus** (Koelz) (Karong, Manipur) Manipur Spotted-breasted Laughing Thrush 1:186

1♂ 40th mile from Miao, Tirap Div., Arunachal Pradesh.

In Indian Handbook (7 p. 3) the key to species requires a white supercilium, but as stated under Field Characters, p. 37, the white is behind and not over the eye. In the absence of any material for comparison it is not possible to decide the race of the single specimen though it agrees with the original description of *merulinus.*

Measurements on p. 162.

1306 **Garrulax sannio albosuperciliaris** Godwin-Austen (Nr. Kaiba, Manipur) White-browed Laughing Thrush 1:144

6: 2♂♂ 4 o?

3 *Maymyo;* 2 *Chatgi-Shia,* 1 *Loi Cuppara, N. Shan States, Burma.*

The 3 from Maymyo (J.P. Cook, 1913) are more rufous below and paler above than the others which were collected by H. Wood. The latter bear no date but there is another specimen (No. 1439) of *Sibia picaoides* collected by H. Wood in N. Shan States on 16 January 1903 and these would be about the same period.

Measurements on p. 162.

1307/8 **Garrulax cachinnans** (Jerdon) (Nilgiris) Nilgiri Laughing Thrush 1:176

10: 3♂♂ 5♀♀ 2 o?

1 Kodanad, beyond Kotagiri; 4 Ootacamund, 1 Upper Bhavani, 2 Avalanche, 2 Naduvattam, Nilgiris.

There is some variation in the extent of grey on the head and the depth of rufous on the underparts.

Measurements on p. 162.

1309 **Garrulax jerdoni jerdoni** Blyth (Banasore Peak) Coorg Whitebreasted Laughing Thrush 1:177

nil.

In Indian Handbook (7 p. 2) in the key to species, this is separated from several others by having the throat and breast grey, *contra* black chin in the others. On p. 41 in the key to subspecies this form is said to show a black chin! The original description says the black is less developed than in *cachinnans.*

1310 **Garrulax jerdoni fairbanki** (Blanford) (Palni Hills) Palni Laughing Thrush 1:178

19: 10♂♂ 4♀♀ 5 o?

The birds from the Palnis are slightly larger than those from N. Travancore and are listed separately:—

(a) Palnis 8: 3♂♂ 5 o?
(b) N. Travancore 11: 7♂♂ 4♀♀

Measurements on p. 163.

1311 **Garrulax jerdoni meridionale** (Blanford) (Mynall, S. Travancore) 1:178

4: 2♂♂ 2♀♀ Muthukuzi, Ashambu Hills, S. Travancore.

The eye stripe turns grey behind the eye while the grey of the breast turns white and runs down the middle of the belly. The head is less distinctly "capped" than in those under *fairbanki.*

Measurements on p. 163.

1312 **Garrulax lineatus bilkevitchi** (Zarudny) (Kulyab, Tadzhikistan) Baluchistan Streaked Laughing Thrush 1:182

nil.

1313 **Garrulax lineatus gilgit** (Hartert) (Gilgit) Gilgit Streaked Laughing Thrush 1:182

6: 3♂♂ 2♀♀ 1 o?

1 Chitral, N.W.F.P., 1 Base of Diobani Mt., 12000′, Bagrot, 1 Godai, Astor; 1 4m. below Yusmarg (7500′), 1 7500′ above Banihal village, 1 7200′ Kashmir.

The second and third in the list above agree best with the description, while the three from Kashmir verge towards nominate *lineatus.*

Measurements on p. 163.

1314 **Garrulax lineatus lineatus** (Vigors) (Simla-Almora) Simla Streaked Laughing Thrush 1:142

25: 12♂♂ 11 (1 juv.) ♀♀ 2 (1 juv.) o?

1 Dalhousie, Punjab; 12 Simla, 1 Koti State, 2 Mussoorie, 1 Dhanaulti, east of Mussoorie; 2 Yoshinath, 1 Lohaghat, 1 Adabadri, Garhwal; 2 Dakuri, Almora, 2 Marnavla, Kumaon, U.P.

The key to subspecies in Indian Handbook (7 p. 44) first divides the five races into two groups on the basis of the subterminal band on the undersurface of the outer rectries as over and under 1 cm. We have no specimens of *G. l. bilkevitchi,* but those available can be more readily divided on the basis of the broad (1 cm.) whitish tips in *lineatus* and *gilgit* contra very narrow white tips in *setafer* and *imbricatus.* The terminal band is more easily seen than the subterminal.

Measurements on p. 163.

1315 **Garrulax lineatus setafer** (Hodgson) (Nepal) Nepal Streaked Laughing Thrush

2: 1♂ 1♀ collected by Lt. Col. R. L. Kennion at Kakani 7000′ and Thunsi 11000′ Nepal on 9 Sept. 1920.

The ♂ agrees with the description in INDIAN HANDBOOK regarding the throat, breast and ear coverts being rufous, but the ♀ is very worn and with almost no rufous. Hodgson's original description refers to the bird as the Spiny Cinlosoma "slaty blue, overlaid with ruddy brown ....". The feathers on the head and neck are said to be rigid and spinous. This description does not apply to the present specimens. Neither show any streaks on the earcoverts.

Measurements on p. 163.

1316 **Garrulax lineatus imbricatus** Blyth (Bhutan) Bhutan Streaked Laughing Thrush 1:183

11: 5♂♂ 4♀♀ 2 o?

1 Gedu, West, 2 Batase, 3 Shamgong, Central, 2 Gomchu, 2 Wamrong, 1 Rongtong, East Bhutan.

The earcoverts and a patch around are prominently pale shafted. The tail is longer than in the other races.

Measurements on p. 163.

1317 **Garrulax virgatus** (Godwin-Austen) (Razam, under Kopamedza Ridge, Naga Hills) Manipur, Streaked Laughing Thrush 1:179

nil.

1318 **Garrulax austeni austeni** (Godwin-Austen) (Hengdan Peak, N. Cachar) Browncapped Laughing Thrush 1:160

nil.

EL **Garrulax austeni victoriae** (Rippon) (Mt. Victoria) Chin Hills Laughing Thrush 1:161

2: 1♂ 1♀ *Mt. Victoria, Burma.*

In the absence of any specimens of the nominate form the subspecific identification is based on their place of origin. The measurements on p. 163 are slightly smaller than those given for the nominate form in Stuart Baker's *Fauna.*

1319 **Garrulax squamatus** (Gould) (Sikkim) Bluewinged Laughing Thrush 1:174

6: 1♂ 3♀♀ 2 o?

1 Kurseong, Sikkim; 1 Honka, West, 1 Batase, Central Bhutan; 1 Miao (Deban), Tirap Div., Arunachal Pradesh; 2 *Pimpri Bam, N. Shan States, Burma.*

Measurements on p. 164.

1320 **Garrulax subunicolor subunicolor** (Blyth) (Nepal) Plain Coloured Laughing Thrush 1:171

7: 5♂♂ 2 o?

1 Mogam, Nepal; 1 Runjeet Valley, Sikkim; 2 Shamgong, Central, 1 Wamrong, East Bhutan; 1 Dreyi, Lohit Valley, N. E. Assam; 1 *Loi Song, N. Shan States, Burma.*

There is some variation in the amount of buff on the underparts and the extent of grey on the earcoverts. The last bird has buff earcoverts and the place of origin suggests the subspecies *griseatus* (Rothschild) (Shweli-Salween Divide, Yunnan) of which the original description is not available, but which is said to occur in Kachin State (just north of N. Shan States) in Peters' *Checklist.*

Measurements on p. 164.

1321 **Garrulax henrici** (Oustalet) (South Tibet = Aio Soutu) Prince Henry's Laughing Thrush 1:183

nil.

1322 **Garrulax affinis affinis** Blyth (Central Nepal) Western Blackfaced Laughing Thrush 1:172

According to the distribution in INDIAN HANDBOOK, none of the specimens available would be of this form.

1323 **Garrulax affinis bethelae** Rand & Fleming (Thangu, Sikkim) 1:172 (part)

10: 3♂♂ 6♀♀ 1 o?

2 Phalut, Darjeeling; 2 Lachung, Sikkim; 2 Chapcha, W. Bhutan, 1 Ganglipoketi, Central Bhutan, 1 Rongtong, East Bhutan; 2 Leu Tsu River, Mishmi Hills.

Measurements on p. 164.

EL **Garrulax affinis oustaleti** (Hartert) (Tzeku, Yunnan)

1 o? *Shaung Mawphy.*

This specimen was collected by F. Kingdon Ward and received at the Society on 24 October 1919. The place cannot be located and the specimen differs from the others in lacking markings on the undersurface. It is marked *oustaleti* by a previous worker(?).

Measurements on p. 164.

1324 **Garrulax erythrocephalus erythrocephalus** (Vigors) (Himalayas, restricted to Chamba by Baker 1920) Redheaded Laughing Thrush 1:163

15: 8♂♂ (2 juv.) 7♀♀ (1 chick).

3 Koti State, 1 Simla Hills, 2 Simla; 1 Almora, 4 Dakuri, 2 Mornaula, 1 Deoban, Jamsar, Kumaon; 1 Dhanaulti, e. of Mussoorie, U.P.

The two juveniles have no spots on the back and to this extent do not agree with the key to species in Indian Handbook (7, p. 3). One (♂

819 Dakuri) is more rufous than the other (♂ 15896 Koti State). The juveniles and the chicks are dated August-September.

Measurements on p. 164.

1325 **Garrulax erythrocephalus kali** Vaurie (Lete, Kali River Valley, Baglung dist., West-Central Nepal) Nepal Redheaded Laughing Thrush 1:163

nil.

1326/7 **Garrulax erythrocephalus nigrimentum** (Oates) (Himalayas, from Nepal to Dafla Hills in Assam, restricted to Sikkim) Sikkim Redheaded Laughing Thrush 1:164

27: 14♂♂ 9♀♀ (1 juv.) 4 o?

1 Kewzing-Temi, 2 Dentam, W. Sikkim; 3 Kurseong, Darjeeling; 1 Honka, 1 Chimakothi, 4 Chapcha, West, 2 Batase, 3 Shamgong, 2 Bhumthang, Central, 1 Deothang, 3 Gomchu, 1 Wamrong, 1 Rontong, East Bhutan; 1 Gujir, Aka Hills,, 1 Shengarh, Dafla Hills, Assam.

There is some variation in the extent of rufous in different parts of the plumage and the last from Shengarh, Dafla Hills (24 Oct. 1876, collected by Godwin-Austen) is very rufous all over.

♀ No. 828 from Kurseong (30 Sept. 1920) with no spots on the upperparts and a 100 mm. wing is presumably a juvenile.

The specimens are quite unlike the illustration in INDIAN HANDBOOK (7: op. p. 16).

Measurements on p. 164.

1328 **Garrulax erythrocephalus chrysopterus** (Gould) (Khasi Hills) 1:166

1♀ Dumpep, Shillong, Assam.

The spots on the back are brownish and crescentic rather than black and more oval. The rufous on the head forms a cap extending almost to the forehead.

Measurements on p. 165.

1329 **Garrulax erythrocephalus godwini** (Harington) (Hengdan Peak, N. Cachar Hills) Nagaland Redheaded Laughing Thrush 1:165

1♀ Mt. Japu, Naga Hills, Assam.

The marking on the breast is very indistinct.

Measurements on p. 165.

1330 **Garrulax erythrocephalus erythrocephalus** (Hume) (Matchi, E. Manipur Hills) Manipur Redheaded Laughing Thrush 1:164

3: 1♂ 2♀♀

1 *Fort White*, 2 *Mt. Victoria, Chin Hills, Burma.*

Measurements on p. 165.

EL **Garrulax melanostigma** (?)

2 o? *Loi Wong, N. Shan States, Burma.*

Both are without markings above and below and have black wing coverts. *G. e. woodi* was described by Harington (JBNHS 23 p. 318) from Loi Song, N. Shan States and though this may not be the same as Loi Wong, it is noticeable that Harington referred to these two (?) at the same time as *G. melanostigma* and not *erythrocephalus* though they are referred to as the same species in Peters' *Checklist* (1964, 10 p. 378).

Measurements on p. 165.

1331 **Garrulax phoeniceus phoeniceus** (Gould) (Nepal) Himalayan Crimsonwinged Laughing Thrush 1:168

6: 3♂♂ 1♀♀ 2 o?

1 Buxa Duars, Bengal; 1 Gedu, West, 1 Tama, 1 Shamgong, Central, 1 Deothang, 1 Narphong, East Bhutan.

There appears to be no colour difference to separate this from *bakeri, infra,* and the separation is made on geographical grounds.

Measurements on p. 165.

1332 **Garrulax phoeniceus bakeri** (Hartert) (Laisung, North Cachar) Assam Crimsonwinged Laughing Thrush

9: 3♂♂ 4♀♀ 2 o?

2 Embiong, Tirap, Arunachal Pradesh; 1 Kohima, Nagaland; 2 N. Cachar; 3 *Mt. Victoria, Chin Hills;* 1 *Sima, Upper Burma.*

Some show a little grey on the lower parts, but the same shows in some under nominate *phoeniceus.* In series this group (1332) is perhaps a slightly paler brown both above and below.

Measurements on p. 165.

EL **Garrulax phoeniceus ripponi** (Oates) (Fort Stedman, Shan States, Upper Burma) Burmese Crimsonwinged Laughing Thrush 1:170

2 o?: 1 *Loi Song,* 1 *Chatzesha, N. Shan States, Burma.*

Measurements on p. 165.

EL **Garrulax milnei sharpei** (Rippon) ("Kauri-Kachin tract to the east of Bhamo, & bordering on the south of the Tapeng River", Kachin State, Burma) Burmese Redtailed Laughing Thrush 1:170

2 o?: 1 *Pimpri Bam,* 1 *Loi Lem, N. Shan States, Burma.*

The bird from Pimpri Bam is appreciably grey on the underparts.

Measurements on p. 165.

1272 Garrulax cinereifrons

	Wing	Bill	Tarsus	Tail
o? 1	112	22.3	32.6	101
	(IH ♂♀ 110-118	from feathers 22-24	—	95-105)

1273/4 Garrulax albogularis whistleri and albogularis

1273 *whistleri* ♂♂ (10)	132-145 av. 137.4	22.7-25.6 av. 24	36.5-43 av. 40.5	132-145 av. 139.4
	(♂♀ 132-144	—	—	—)
♀♀ (12)	132-142 av. 135.3	22-25 av. 23.8	31.5-42.5 av. 39.4	134-145 av. 139.4
	(IH 1 ♀ 137	from skull 23	43	149)
o? (3+1 juv.*)	128, 135, 142	22.2, 23.5, 25, 20.2*	37.6*, 40, 41, 41.2	132, 143, 147, 102*
1274 *albogularis* ♂♂ (7)	127-140 av. 133.0	22-25.2 av. 23.9	39.8-44.5 av. 42.3	132-139 av. 133.5
	(IH 123-136	from skull 25-30	45-48	123-141)
albogularis ♀♀ (5)	124-132 av. 128.4	23.1-24.4 av. 23.7	41.5-42.5 av. 42.1	126-136 av. 130.8
	(IH 122-135	from skull 24-30	45-48	125-137)

1275/6 Garrulax moniliger moniliger/badius

	Wing	Bill	Tarsus	Tail
♂♂				
1275 *moniliger* (3)	122, 124, 126	25, 28, 28.7	35.5, 38.5, 39.6	120, 121, 122
	(IH 119-132	from skull 29-30	41-44	121-132)
1276 *badius* (6)	125-130 av. 124.3	26.2-29.5 av. 27.6	36-39.7 av. 38	121-130 av. 123.6
	(IH ♂♂ 120-124	—	—	— SDR)
♀♀				
1275 *moniliger* (3)	121, 126(2)	25, 27, 28	35.5, 37.5, 38.8	120, 123, 125
	(IH 116-126	—	—	—)
1276 *badius* (4)	118, 122, 123, 129	25, 25.5, 27.2, 27.5	35, 35.5, 35.6, 36.3	120, 124, 130, 132

1278 Garrulax pectoralis melanotis

♂♂ *melanotis* normal (8)	138-157 av. 141.2	30-32.7 av. 31.5	42-44.8 av. 42.9	123-145 av. 130.6
melanotis pale (3)	137, 145, 149	31.8, 31.9, 37.5	42, 42.5, 46.9	133, 133, 145
	(IH 130-152	from skull 32-36	46-48	122-148)
♀♀ *melanotis* normal (4)	139, 140, 140, 143	30.6, 30.5, 31.4, 31.5	43, 43, 44, 45	124, 126, 135
melanotis pale (3)	141, 143, 149	30.5, 31.4	41, 41.7, 42	120, 124, 125
	(IH 130-148	from skull *c.* 35	46-49	118-135)

1279/82 Garrulax striatus subspp.

1279 *striatus* (8)	142-151 av. 148.1	26.2-28.1 av. 27	39-43.5 av. 41.2	129-140 av. 133.8
	(IH ♂♀ 145-165	from skull 27-28	—	139-148)
1280 *vibex* (3)	141, 142, 146	28, 28.7	39.5, 40.5, 45	122, 126(2)
	(IH ♂♂ 138-151	from skull 26-30	42	128-138)
1281 *sikkimensis* (2)	129, 144*	25.3, 28.8*	37.5, 45*	113, 127*
	(IH ♂♀ 126-152 mostly 130-142	from skull 23-30	39-47	121-137)

* specimen purchased in Bombay

♂♂	Wing	Bill	Tarsus	Tail
1282 *cranbrooki* (2)	134, 141 (IH ♂♂ 134-149	27.7, 28 from skull 29-31	42, 45 —	121, 135 120-129)
♀♀				
1279 *striatus* (8)	144-155 av. 148	24.3-27.9 av. 25.9	37-44 av. 41.4	131-143 av. 134.5
1280 *vibex* (1)	137 (IH ♀♀ 132-142	24.5 from skull 27-30	42.6 42	126 126-139)
1281 *sikkimensis* (3)	135 (3)	24, 25.5 (2)	38.3, 39.2, 42.6	120, 123, 126
1282 *cranbrooki* (10)	127-141 av. 136	24.8-27.5 av. 26.1	36.6-40 av. 39	119-130 av. 121.7

1283/84 **Garrulax leucolophus** subspp.

♂♂	Wing	Bill	Tarsus	Tail
1283 *leucolophus* (14)	125-139-av. 132.3	25-30.4 av. 26.7	39.6-42.7 av. 41	114-134 av. 124
1284 *patkaicus* (8)	119-136 av. 129	24.5-28.9 av. 27.2	37.2-44.5 av. 40.0	114-128 av. 120.3
EL. *belangeri* (1)	124	28	41.4	108

(Fauna: rather smaller than **leucolophus** with wing about 125-130 mm.)

♀♀	Wing	Bill	Tarsus	Tail
1283 *leucolophus* (10)	126-136 av. 131.4	26-28 av. 27.2	37.5-43.7 av. 41.1	115-129 av. 120.1
1284 *patkaicus* (1)	imm. 130	25.8	41	124
EL. *belangeri* (3)	125, 128, 132	28, 28.5, 31	38, 42, 44	112 (2), 115

1285 **Garrulax chinensis nuchalis**

	Wing	Bill	Tarsus	Tail
♀♀ (2)	111, 116 (IH ♂♀ 106-117	22.6, 23.5 from skull 26-27	38.7, 41 40	114, 116 106-115)

EL. **Garrulax chinensis lochmius**

	Wing	Bill	Tarsus	Tail
o? (4)	105-113	23-25	33.8-40.5	105-116

1287/88 **Garrulax delesserti** subspp.

♂♂	Wing	Bill	Tarsus	Tail
1287 *delesserti* (3)	105, 108, 111 (IH 100-113	27.7, 28.6, 30 from skull 30-31	32.2, 35.8, 36.5 39	100, 102, 107 97-107)
1288 *gularis* (1)	102 (IH ♂♀ 95-104	28 from skull 29-32	38 38-42	92 90-94)
♀♀				
1287 *delesserti* (2)	100, 108 (IH 108-113	27.5, 27.8 31	31.9-37.5 —	98, 98 101-106)
1288 *gularis* (4)	97-102	26.5-28.7	34-35.7	86-91

1289/90 **Garrulax variegatus** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1289 *similis* (3)	101, 102, 102	17, 20, 20.2	31.1, 34.5, 35	108, 115, 115
	(IH same as 1290)			
1290 *variegatus* (20)	98-117 av. 105.3 (IH 101-109	19.3-26.1 av. 21.3 from skull 23	31.2-36.5 av. 34.4 38	111-126 av. 118 120)
♀♀				
1289 *similis* (4)	95, 98, 99, 100	18.5, 19.4, 21.1, 21.2	32, 32.5, 34.1, 35	90*, 107, 111, 117
1290 *variegatus* (8)	96-102 av. 99.5	18.7-22.2 av. 20.5	30.8-36.0 av. 33.6	102-117 av. 112.7 *Tail moulting
	(IH 98-103	—	—	—)
1291 **Garrulax cineraceus cineraceus**				
♂ (1)	82	21.4	29.2	92
	(IH ♂♀ 86-89	from skull 20	32	100)
o? (1)	85	20.9	30.9	89
1292/1296 **Garrulax rufogularis** subspp.				
♂♂				
1292 *occidentalis* (3)	90, 97, 96	20.3, 21.5, 22.1 (IH as in 1294)	27.2, 31.2, 31.3	101, 103, 106
1294 *rufogularis* (5)	91-97 av. 94.8 (IH ♂♂ 88-98	22-25 av. 23.3 from skull 23-24	30-35.8 av. 33 *c.* 35	99-103 av. 102 98-110)
1296 *assamensis* (2)	89, 92,	22.4, 22.4 (IH as in 1294)	32.4, 34.9	92, 95
♀♀				
1292, 1293 *occidentalis* (3)	90, 95, 98	20.1, 21.5, 22.1 (IH as in 1294)	26.4, 29, 31.2	99, 102, 105
1294 *rufogularis* (4)	88, 89, 91, 95	23.7, 23.7, 24.3, 25	32.5, 32.5, 32.6, 35.7	90, 92, 94, 98
	(IH ♀♀ 87-99	from skull 23-25	*c.* 37	97-103)
1296 *assamensis* (1)	92	23.2 (IH as in 1294)	36.1	94
o?				
1292, 1293 *occidentalis* (1)	94	21.4	32.5	106
1294 *rufogularis* (1)	93	24.3	35.3	101
1298/1299 **Garrulax ocellatus** subspp.				
♂♂				
1298 *griseicauda* (3)	126, 128, 130	25.9, 26.9, 28.5	41.2, 42.5, 42.7	115*, 156, 164 (*Tail moulting)
	(IH ♂♂ 135 (type)	from skull 33	—	163. 167)
1299 *ocellatus* (1)	133	28.8	42.2	151
	(IH ♂♂ 122-135	from skull 27.30	—	146-162)
♀♀				
1298 *griseicauda* (1)	123	Bill broken	41	159
	(IH ♀♀ 132-136	from skull 31-32	—	157-164)

	Wing	Bill	Tarsus	Tail
♀♀				
1299 *ocellatus* (3)	122, 125, 132	—, —, 28	40.7, 43, 46	141, 142, 149
	(IH ♀♀ 117-137	28-29	45	148-161)
1299 *ocellatus* o? (1)	117	28.6	44.5	144
	1300 et al. **Garrulax c. caerulatus** and **kaurensis**			
1300 *caerulatus* ♂♂ (3)	107, 109, 112	25.7, 26.5, 26.5	38, 38.5, 40	115, 119, 129
	(IH ♂♂ 106-115	from skull 24-28	41-43	124-133)
„ *caerulatus* ♀♀ (3)	106, 108, 111	26.2, 26.6, 26.6	38, 38.2, 39	118, 121, 122
	(IH ♀♀ 103-110	25-29	40-42	122-131)
„ *caerulatus* o? (2)	108, 108	25, 27.1	37, 40.5	125, 125
EL *kaurensis* o? (2)	109, 112,	24.5, 27.5	31.8, 37	115, 123
	(104.6	26.6	40.6	115.3 Rippon)
	1303 **Garrulax ruficollis**			
♂♂ (6)	94-104 av. 98.5	21.7-23.7 av. 22.7	31.7-35 av. 33.3	98-108 av. 103.5
♀♀ (8)	93-98 av. 96	21-24.1 av. 23	29.3-34.6 av. 32.6	93-106 av. 101
o? (10)	94-102 av. 98.5	20.3-24.5 av. 21.7	32.6-34.6 av. 33.8	98-108 av. 103.3
	(IH ♂♀ 96-100	from skull 23-24	36-37	101-111)
	1305 **Garrulax merulinus toxostiminus**			
♂ (1)	97	25.4	38.5	85
	(IH ♂♀ 93-99	24	40	96-100)
	1306 **Garrulax sannio albosuperciliaris**			
♂♂ (2)	95, 101	22.3, 22.5	30.7, 33.2	93, –* (*Tail lost)
o? (4)	93, 95, 96, 99	21.4, 23.6, 24.2, –*	30.5, 31, 32.5, 33	93(2), 108, 109
		(*Bill broken)		
	(IH ♂♀ 93-104	from skull 22-25	37	105-117)
	1307/8 **Garrulax cachinnans**			
♂♂ (3)	88, 90, 91	20.2, 21.8(2)	30.4, 30.9, 33	91, 94(2)
	(IH ♂♀ 92-96	16-18	30-32	100)
♀♀ (5)	85-93 av. 89.2	19.9-20	29.8-36 av. 32.3	84-93 av. 90.4
	(IH 2 ♀♀ 85, 89	from skull 22	32	86, 94)
o? (2)	90 (2)	20, 20.6	31, 32.5	94, 96

1310 **Garrulax jerdoni fairbanki**

	Wing	Bill	Tarsus	Tail
♂♂				
a) (3)	88, 89, 91	20, 20.7, *broken	29.1, 32.3, 33.2	91, 93, *missing
b) (7)	85-90 av. 87.5	18.7-21.3 av. 20	30.8-33.4 av. 32.1	87-92 av. 89
	(IH ♂♂ 83-91	21-23 from skull	33-35	86-97)
♀♀				
b) (4)	82, 84(2), 88	20, 20.3, 20.4,* *broken	28.8, 31.7, 32, 32.1	79, 87, 89, 90
	(IH ♀♀ 81-86	20-23	33-35	86-92)
o?				
a) (5)	86-91 av. 88.6	18-21 av. 19.6	31.4-32.9 av. 32.2	85-93 av. 89.4

1311 **Garrulax jerdoni meridionale**

	Wing	Bill	Tarsus	Tail
♂♂ (2)	88, 92	20.2, 20.5	32.4, 34	93, 94
	(IH ♂♂ 85-88	21-22 from skull	35-36	95-96)
♀♀ (2)	83, 87	18, 19.5	31.5, 32.1	82, 95
	(IH ♀♀ 84-85	20	35	96)

1313/1316 **Garrulax lineatus** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1313 *gilgit* (3)	82, 83, 84	15.9, 16 4, 17.7	24.1, 25.6, 29.2	88, 91, 91
		(IH as in 1314)		
1314 *lineatus* (12)	77-84 av. 81.2	15.8-18 av. 17.5	25-27.8 av. 26.3	84-95 av. 89.4
	(IH 71-81	—	—	—)
1315 *setafer* (1)	78	17.2	26.2	89
	(IH 77-81	from skull 18-19	c. 29	90-97)
1316 *imbricatus* (5)	78-80 av. 78.8	16.9-18.3 av. 17.3	26-28.5 av. 27.4	97-102 av. 98.4
♀♀	(IH 77-82	from skull 17-21	29-34	84-102)
1313 *gilgit* (2)	81, 82	16, 16.8	25.4, 26.5	80, 92
		(IH as in 1314)		
1314 *lineatus* (11)	78-84 av. 81.1	14.1-18 av. 16.2	23.2-27.7 av. 25.7	85-96 av. 90.6
1315 *setafer* (1)	78	15.4	25.6	85
	(IH 72-80	c. 19	c. 29	c. 90)
1316 *imbricatus* (4)	77(3), 78	17.7, 18.5, 18.7	24.4, 26.2, 27.1, 27.4	90, 93, 99, 100
	(IH 74-80	from skull 18-20	30-33	94-102)

EL **Garrulax austeni victoriae**

	Wing	Bill	Tarsus	Tail
♂ (1)	92 (94 in Fauna ex Rippon)	17.5	32	103
♀ (1)	91	17.6	34	106
	(Nominate ♂♀ 90-100	c. 20	c. 35	c. 120)

1319 Garrulax squamatus

	Wing	Bill	Tarsus	Tail
♂ (1)	101	21	36.2	97
♀♀ (3)	96, 98, 99	20.7, 21.7, 22.5	33.5, 34.5, 35	94, 96, 99
o? (2)	98, 104	19.8, 22	34, 37.5	93, 100
	(IH ♂♀ 99-105	from skull 24-25	39	97-103)

1320 Garrulax subunicolor subunicolor

♂♂ (5)	92-100 av. 95.4	16-18.4 av. 17.2	33.3-38.7 av. 34.9	98-116 av. 104.6
o? (1)	96	16.7	35	111
	(IH ♂♀ 90-100	19-20 from skull	36-40	95-120
				Mayr, SDR, SA)

1323 Garrulax affinis bethelae

♂♂ (3)	109, 111, 116	—, 17.5, 19.6	33, 36.5, 37	120, 129, 130
	(IH ♂♂ 98-115	24(2) from skull	36-40 (3)	134-135 (2))
♀♀ (6)	100-114 av. 105	20.2-22.1 av. 20.6	32.8-36 av. 34.8	110-120 av. 116.4
	(IH ♀♀ 102-110	23(2)	39-42 (2)	118-127 (2))
o? (1)	107	—	35	123

EL. Garrulax a. oustaleti

o? (1)	110	22.7	35.4	123

1324/1330 Garrulax erythrocephalus subspp.

♂♂				
1324 *erythrocephalus* (8)	102-112 av. 106	20.5-23 av. 21.4	35-38 av. 36.1	107-125 av. 118.3
	(IH 100-105	from skull 25-26	—	114-117)
1326 *nigrimentus* (14)	100-107 av. 103.5	20.5-24.8 av. 22.9	35.5-40.6 av. 38.2	107-118 av. 112.3
	(IH 97-107	from skull 23-25	37-43	110-124)

1324/1330 **Garrulax erythrocephalus**

	Wing	Bill	Tarsus	Tail
1330 *erythrolaema* (1)	100	23.2	37.3	119
	(IH 98-106	—	—	—)
♀♀				
1324 *erythrocephalus* (6)	99-102 av. 101	20.6-23.3 av. 21.7	33.2-37.2 av. 34.8	106-114 av. 118.5
	(IH 92-105	from skull 24-25	—	106-108)
1326 *nigrimentus* (9)	98-107 av. 101.5	21.6-24.2 av. 22.8	33.2-38.8 av. 36.4	100-112 av. 107.9
	(IH 93-103	from skull 22-25	39-42	105-125)
1328 *chrysopterus* (1)	100	21.7	38.6	107
	(IH ♂♀ 101-106	20-21	38	110-115)
1329 *godwini* (1)	98	22	34.5	112
	(IH ♀♀ wing 93-106)			
1330 *erythrolaema* (2)	103, 106	22, 24	37.1, 39	110, 110
	(IH 92-102	—	—	—)
o?				
1326 *erythrocephalus* (4)	100-104	19-23.5	34.2-35.5	108-116

EL. **Garrulax melanostigma**

o? (2)	106, 112	21.6, 22	34.5, 35.3	111, 119

1331/1332 **Garrulax phoeniceus** subspp.

♂♂				
1331 *phoeniceus* (3)	89, 95 (2)	19.5, 19.7, 20	28.3, 33.8, 34	96, 106, —
	(♂♀ 81-93	18	32	100)
1332 *bakeri* (3)	85, 85, 89	17.5, 18.5, 20	28.8, 30.5, 31.7	96, 96, 98
	(IH 85-90	—	—	—)
♀♀				
1331 *phoeniceus* (1)	87	—	31.5	95
1332 *bakeri* (4)	81, 83, 84, 90	18.4, 18.4, 19, 19.5	29, 29.5, 32.3, 33.7	85, 85, 92, 94
	(IH 79-87	—	—	—)
o?				
1331 *phoeniceus* (2)	87, 90	16.8, 17.7	33, 33.5	86, 93
1332 *bakeri* (2)	89 (2)	20, 20.5	33.3, 33.9	92, 111
EL. *ripponi* o? (2)	95, 102	21.5	30, 34	100, 108

EL. **Trochalopterum milnei sharpei**

o? (2)	102, 106	22.5, 23.8	35, 36.5	112, 113

(*to be continued*)

NEW DESCRIPTIONS

DESCRIPTIONS OF THREE NEW SUBSPECIES OF BUTTERFLIES FOUND IN NEPAL[1]

C. P. Smith[2]

(*With four text-figures*)

(1) **Parnassius epaphus chiddii** spp. nov.

The Common Red Apollo, *P. epaphus* (Oberthur 1891) is widely distributed all along the Himalayan range. In Nepal it is generally rarer than the Common Blue Apollo, *P. hardwickei* (Gray 1831) being restricted to higher altitudes, and it therefore seems more naturally to form isolated races. This is indeed the fourth one to be described from Nepal, the others being—

P. epaphus boschmai (Eisner 1964) from Solu Khumbu in E. Nepal.

P. epaphus robertsi (Epstein 1979) from Manang in C. Nepal,

P. epaphus capdevillei (Epstein 1979) from Mustang in C. Nepal.

P. epaphus chiddii was found in one locality in the remote Mugu district of N. W. Nepal in the Summer of 1980.

DESCRIPTION

Male—upperside: Ground colour-forewing is transparent white heavily dusted with black, hindwing is opaque white. The black markings follow the usual pattern and are heavy. The forewing submarginal black spots are completely joined up to form a diffuse band, leaving only a narrow band of white spots between this and the almost entirely grey margin. The marginal white spots are small and faint. The hindwing submarginal spots are also joined into a chain of black lunules, again leaving only a very narrow band of white between that and the marginal grey. The hindwing red spots are large and bright.

The underside corresponds with the upper, having heavy black, and prominent red markings.

Female—This is identical in markings to the male. Note that in many forms of *P. epaphus* the female is darker.

DIFFERENCES WITH OTHER SUBSPECIES

The main difference with the other three subspecies given above is the submarginal band of both fore and hindwings. The closest approach to this is found in some *P. epaphus robertsi* females. A summary of the main features of all four subspecies is given below. Note that the following features are *not significant*—

(a) The forewing preapical red spots — two specimens have 2, one has 1 and two have none (under and uppersides the same in each case.)

(b) The upperhindwing anal red spot—present in three, absent in two.

SIZE

Measurement—forewing—base to apex = 25 mm. (both sexes.)

HABITAT

It was found on an open rocky ridge above the tree-line. The south side was a precipitous

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[1] Accepted March 1982.

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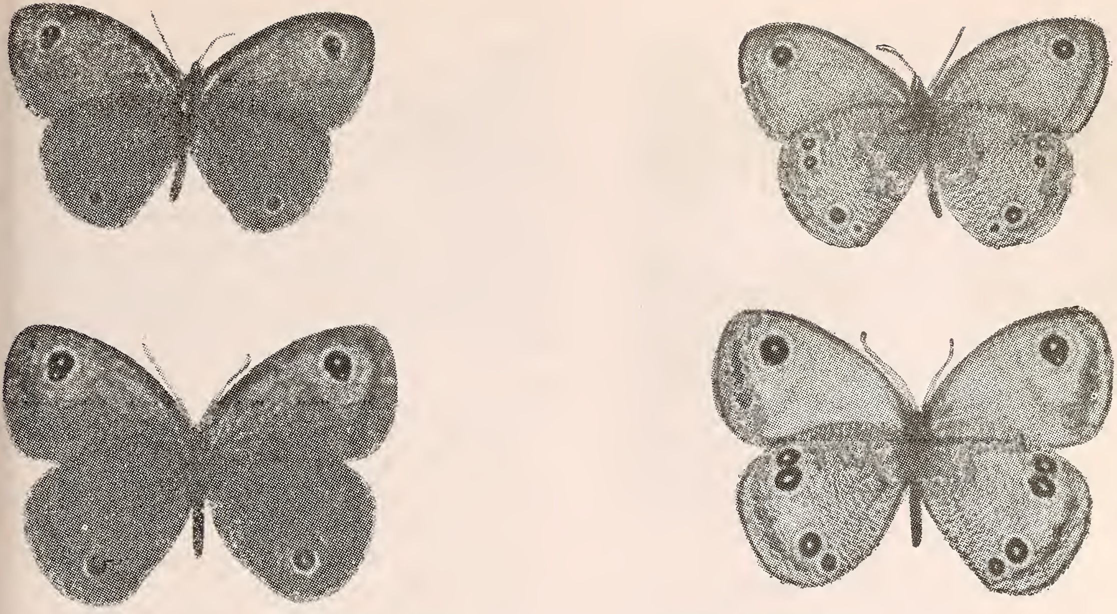


1. *Dallacha hyagriva hyagriva* (for comparison with others)
male — male underside
female — female underside
Courtesy: British Museum, Natural History.

slope with little vegetation, and the north side was a very steep grassy one. Further up the ridge was entirely of rocks with scarcely any vegetation.

DATA

Holotype — female — Lekh above Chiddi — 13000 ft. (=4000 m.) 1 Aug. 80.
Allotype — male — Lekh above Chiddi — 13000 ft. (= 4000 m.) 2 Aug. 80.
Paratypes — 1 m, 2 f — Lekh above Chiddi — 13000 ft. (= 4000 m.) 2 Aug. 80.

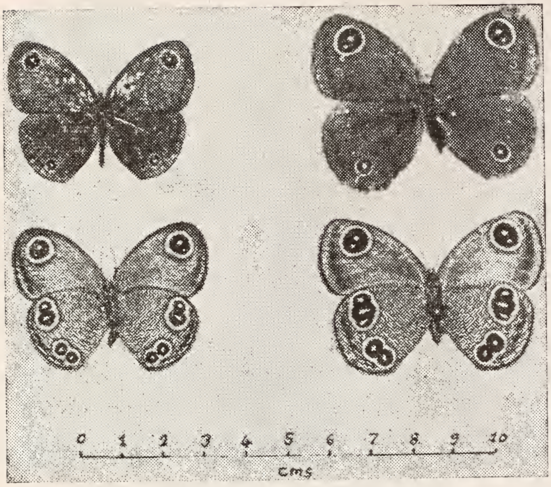
(2) **Metaporia leucodice debdice** ssp. nov.

The Himalayan Blackvein, *M. leucodice* (Eversmann) occurs commonly in the Western Himalayas, but until 1980 had not been recorded as far east as Nepal. It was found locally plentiful in the little explored Jumle area of N. W. Nepal, and has been named after the Nepali collector who obtained the first specimen (the Holotype).

DESCRIPTION

Male — Upperside white, forewing with black discocellular bar and postdiscal band (from 2 to costa, bulging outwards in 4), veins and termen narrowly black. Hindwing — ends of veins and termen narrowly black; discal sagittate line showing through from below. Underside-Forewings white, apex pale creamy yellow; black markings as above, but post discal band and termen less heavily marked. Hindwing pale creamy yellow, precostal area bright yellow; veins uniformly black, fine but clearly defined discal sagittate line.

Female — above as male, but very slightly yellowish, and forewing postdiscal band heavier. Below — exactly as male, except the yellow on hindwing is one shade deeper.



2. *Dallacha hyagriva nepalica*
male — female
male underside female underside
Courtesy: Natural History Museum, Nepal.

Size

Measurement — forewing (base to apex) —
Male — 26-31 mm. (average 30 mm.)
Female — 30-32 mm.

Discussion of subspecies

M. leucodice soracta (Moore 1857) would be the subspecies expected in Nepal (reportedly common at Mussoorie.) But this ssp. has the upperforewing postdiscal band obsolete in 3, which is certainly not the case of these Nepal specimens.

M. leucodice sara (Evans 1932) from Kumaon would also be possible, but that has the upperhindwing discal sagittate line strongly marked in the female which is hardly true of the present specimens. Also the upperforewing is supposed to have large spots in 2 and 4, which isn't how the present specimens would normally be described where those spots are part of a line also going through 3.

It is therefore suggested that these Nepal specimens should be considered a new subspecies.

Habitat

It was found at first in open country, mostly around flowering bushes, often settling high on the leaves, and sometimes on flowers. Later on it was found at slightly higher altitude on the edge of the jungle area. Total altitude range — 7600-8500 ft. (2320-2600 m.) All specimens except the paratypes (e) were from the Jumla area.

Data

Holotype — male — Bora Gau, JUMLA 19 May '80 7800 ft. (2380 m.)
Allotype— female — Bora Gau, JUMLA 20 May '80 7600 ft. (2320 m.)
Paratypes — (a) 1 m type locality 19 May '80 7800 ft. (2380 m.)
(b) 9 m type locality 20 May '80 7800 ft. (2380 m.)
(c) 2 m Jagard Khola 20 May '80 7900-8000 ft. (2410-2440 m.)

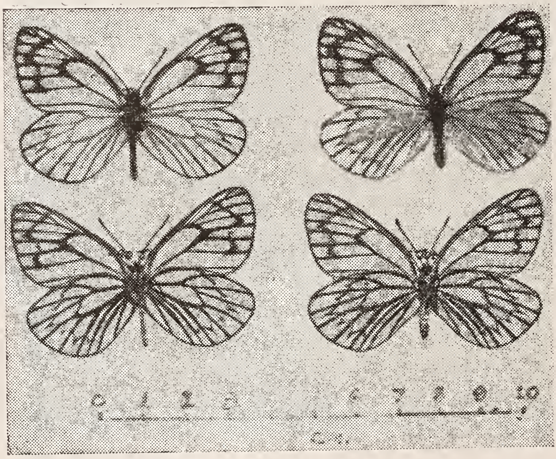


Fig. 3. *Metaporia leucodice debdice*
Male — female
male underside female underside
Courtesy: Natural History Museum, Nepal.

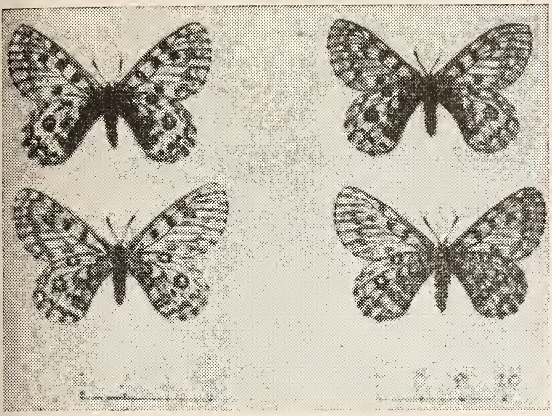


Fig. 4. *Parnassius epaphus chiddii*
male — female
male underside female underside
Courtesy: Natural History Museum, Nepal.

(d) 13 m Poi Village 23 May '80 8000 ft. (2440 m.)

(e) 2 m Gumgardhi W. (MUGU) 30 May '80 8300 ft. (2530 m.)

(f) 7 m Jumla N. W. 3 June '80 7900 ft. (2410 m.)

(g) 4 m, 3f type locality 4 June '80 7800-8500 ft. & above (2380-2600 m.)

(h) 8 m, 2f type locality 5 June '80 7800 ft. (2380 m.)

(3) **Dallacha hyagriva nepalica** ssp. nov.

It is difficult to tell who to attribute this to, since the species has been recorded in Nepal for a number of years. There are Nepal specimens of the Brown Argus, *D. hyagriva* (Moore 1857) in the British Museum Collection which are obviously different from those from the Western Himalayas. It appears that no-one has yet described them. The types were obtained by me in 1975.

Description

Male — above dark brown with very slight submarginal dark bands, a large bipupilled apical ocellus on the forewing, and a smaller single pupilled tornal one on the hindwing; sometimes additional minute ones on the forewing in space 2 or on the hindwing in space 1.

Below — forewing plain brown, hindwing mottled; submarginal bands pronounced. Forewing ocellus as above; hindwing with two pairs (apical and tornal) of conjoined ocelli: apical one has black rings always joined, and sometimes a third white pupil, tornal one has black rings touching or nearly so.

Female — As male but larger and with ocelli larger. The yellow ring round the apical ocellus of the upperforewing of the holotype is 7 mm. in diameter.

Difference with nominate race

The main difference is the larger size of these ocelli, also the fact that the underside tornal ones are subequal, and the underside colour slightly more greyish.

Size

Measurement — forewing base to apex —
Male — 22-23 mm.
Female — 26-28 mm.

Habitat

It inhabits open jungly hillsides, and is less confined to shady places than the related *Callerebias*. It is often found by streams, but usually singly, and has not been observed to congregate on damp ground as the *Callerebias* have.

Distribution

It occurs in both far East Nepal (East of Arun), and in Central Nepal in Gandaki basin (paratypes (1)-(3)) with a total altitude range of 2600-4900 ft. (800-1500 m.).

Note — Specimens from Kathmandu Valley (between the two localities, but at higher altitude) appear to belong to the nominate race, as do those from further west in Nepal.

Data

Allotype male — Ilam 24 Sept. '75 4300 ft.

Comparison of the four Nepal subspecies of *Parnassius epaphus*

	boschmai	*capdevillei*	*robertsi*	*chiddii*
Forewing length	22-23 mm	24-25 mm	25-26 mm	25 mm
Ground colour	white	white	grey	F.W. grey, H.W. white
Black markings	light	light	heavy	heavy
Red spots (H.W.)	small orange	large red	large red	large red
F. W. submarginal black markings	irregular narrow band	band at apex, separate spots at tornus	uniform distinct band	wide diffuse band
H. W. submarginal black markings	narrow lunules-touching	v. small lunules-separate	large lunules-separate	wide lunules-joined

(1300 m.)

Holotype female — Ilam 3 Oct. '75 4400 ft. (1340 m.)

Paratypes (1) m. Barang Barung GORKHA 8 Oct. '77 3400 ft. (1040 m.)

(2) f. Maikot, GORKHA 12 Oct. '77 3900 ft. (1200 m.)

(3) m. Phaewa Lake, POKHARA 23 Sept. '79 2700 ft. (820 m.)

(4) m. Sallari Ban, DANKUTA 18 Oct. '79 4400 ft. (1340 m.)

(5) f. Kowrini, TERATHUM 21 Oct. '79 4900 ft. (1500 m.)

(6) f. Phidim 23 Oct. '79 3600 ft. (1100 m.)

(7) f. Chisso Pani, ILAM 1 Nov. '79 2600 ft. (800 m.)

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DESCRIPTION OF A NEW GENUS *NIRMALADIA* FOR THE SPECIES *CULLADIA DENTILINEALIS* HAMPSON (LEPIDOPTERA: CRAMBINAE)[1]

H. S. Rose[2]

(*With seven text-figures*)

Culladia dentilinealis Hampson is not congeneric with other species of genus *Culladia* Moore, as evidenced from the structure of different body parts. The species has been accordingly put under a new genus *Nirmaladia.*

INTRODUCTION

During an exhaustive collection survey of Pyralid moths from North India in the last five years or so, I collected one hundred and forty-five species belonging to different subfamilies of family Pyralidae. Out of these, seven species are referable to the subfamily Crambinae. One of the Crambin species namely, *Culladia dentilinealis* Hampson does not agree with the description of the diagnostic features of its type-species (*Araxes admigratella* Walker) and is also not congeneric with other described species under this genus (Hampson 1895, 1896; Bleszynski 1970). The characters possessed by the species, *Culladia dentilinealis* are so unique and conspicuous that it requires a new genus and, accordingly, the genus *Nirmaladia* is proposed to form a new combination *N. dentilinealis* (Hampson).

OBSERVATIONS AND DISCUSSION

The genus *Culladia* was first erected by Moore (1886) in order to replace the preoccupied generic name *Araxes* (Walker 1863), the latter being established on the type-species *admigratella* Walker. This type-species along with other *Culladia* spp. were further examined by Hampson (1895, 1896, 1919), who slightly improved the diagnostic characters of this genus by adding the venation of the fore and hind wings. Later, Bleszynski (1963, 1970) revised and redefined the genus *Culladia,* which he considered to be a waste basket for species belonging to several distinct genera. He, thus, suggested a rearrangement of the species referred to this genus alongwith the erection of new genera allied to *Culladia* (Bleszynski 1970a). He however, reluctantly retained the species *dentilinealis* Hampson under the genus *Culladia* although he made a mention of the exceptional features possessed by this species. Recently, Gaskin (1973) pointed out that Bleszynski has failed to give characters exclusive to *Culladia* and distinct from the characters of other allied genera.

In the course of present studies, I examined fifteen specimens of the species under reference and identified it as *Culladia dentilinealis,* first described by Hampson (1919). Its identity is definite because it completely agrees with the description given by Hampson (1919) and its genitalia are similar to those figured by Bleszynski (1970). A careful examination of the present species reveals that the structure of the antennae, the venation of the wings and the various constituent parts of the genitalia are quite distinct and different from those of *Culladia.*

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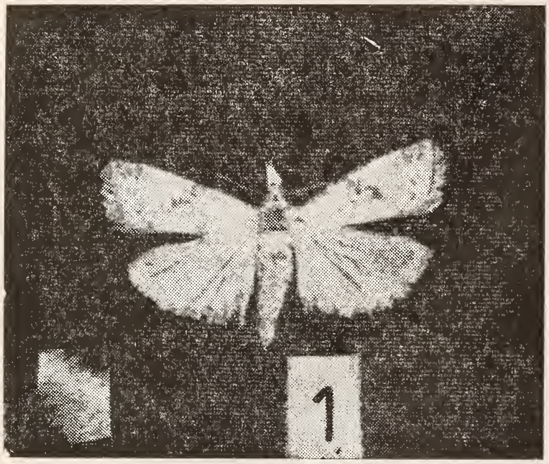


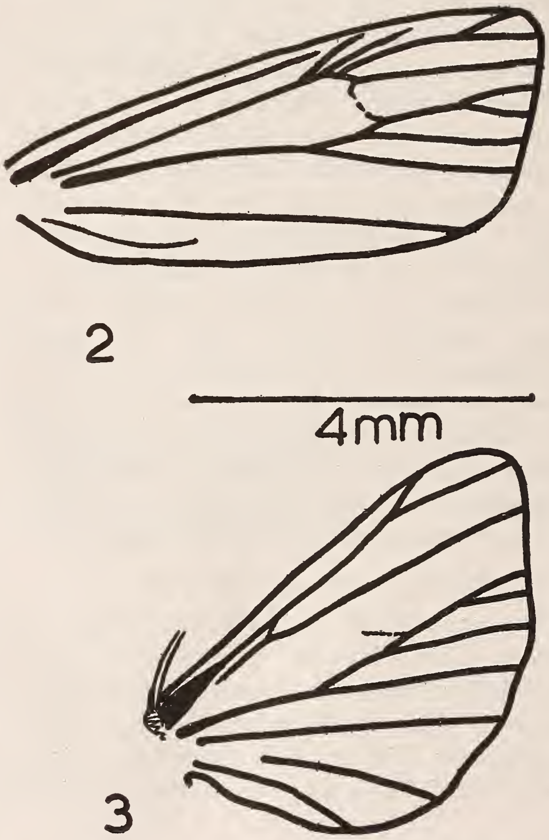
Nirmaladia dentilinealis (Hampson)
Fig. 1. Photograph of the adult moth.

The structure of the antenna in male *dentilinealis* Hampson, is not serrate as in other *Culladia* spp. and also the ocellus is extremely poorly developed in the former as compared to the well developed ocellus in latter. In *Culladia,* the vein R_5 of the forewing is very short and stalked with R_4 but in the species under reference, the veins R_3 and R_4 are stalked and vein R_5 is quite long and arises independently from the discal cell. The veins M_2 and M_3 of the hind wing are stalked in *dentilinealis* whereas one of them is either absent or vestigial in *Culladia.* The male genitalic structures of the present species differ drastically from *Culladia* in many important characters namely, lacking a fine hook at the distal end of the uncus, the complete absence of apical processes of the aedeagus and in having a single long cornutus in the vesica. The structure of the valvae is very unique and of rare occurrence (I have dissected one hundred and forty-five species of family Pyralidae and this is perhaps the solitary example where such type of valva occurred). The female genitalia in *dentilinealis* Hampson is conspicuous in lacking a scobinate signum in its corpus bursae and by the absence of anterior apophyses. The abdomen of the female in *Culladia* is furnished apically with broad scales and such scales are completely wanting in *dentilinealis.*

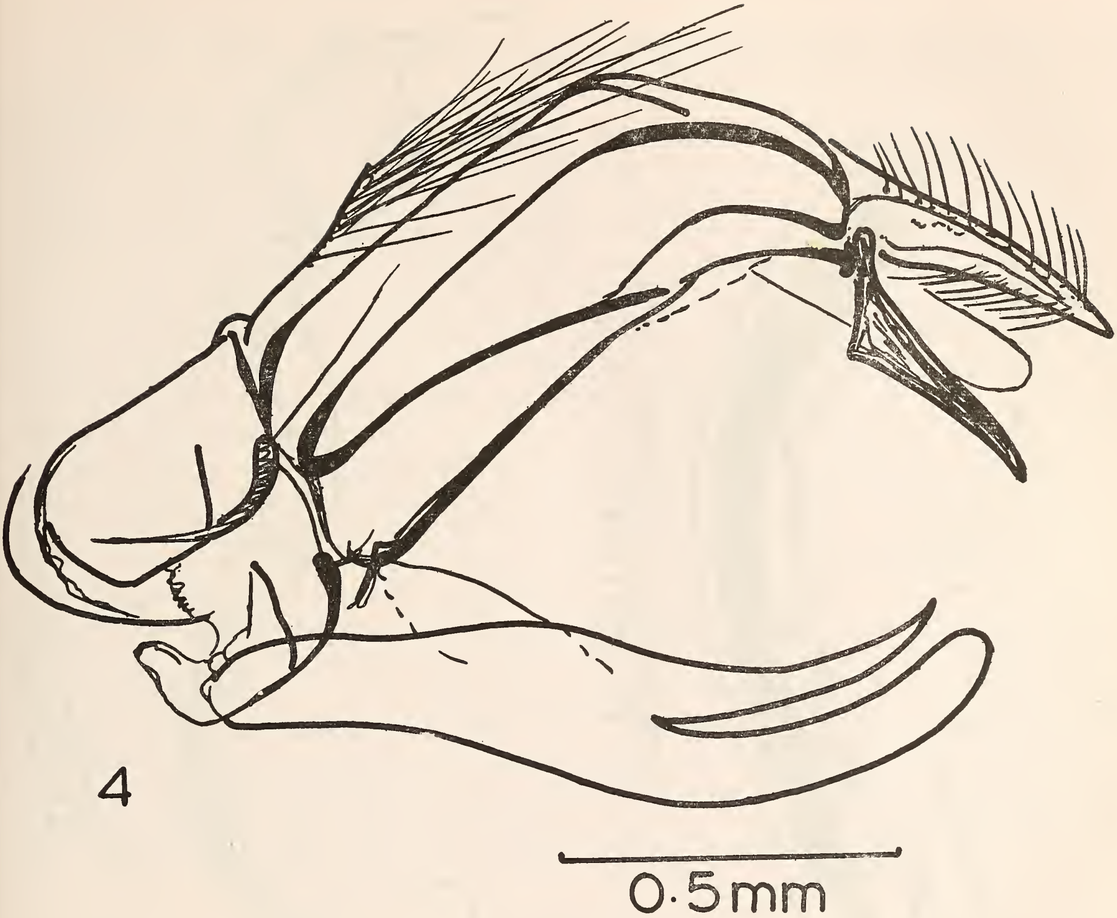
Keeping in view these differences of the species, I am proposing a new genus for it. The genus is named as *Nirmaladia* gen. nov., which is characterised below :

Genus : **Nirmaladia** gen. nov.

Type-species: *Culladia dentilinealis* Hampson Ann. Mag. nat. Hist. (9) 3: 286.



Nirmaladia dentilinealis (Hampson)
Figs. 2 & 3. Fore and hind wing.



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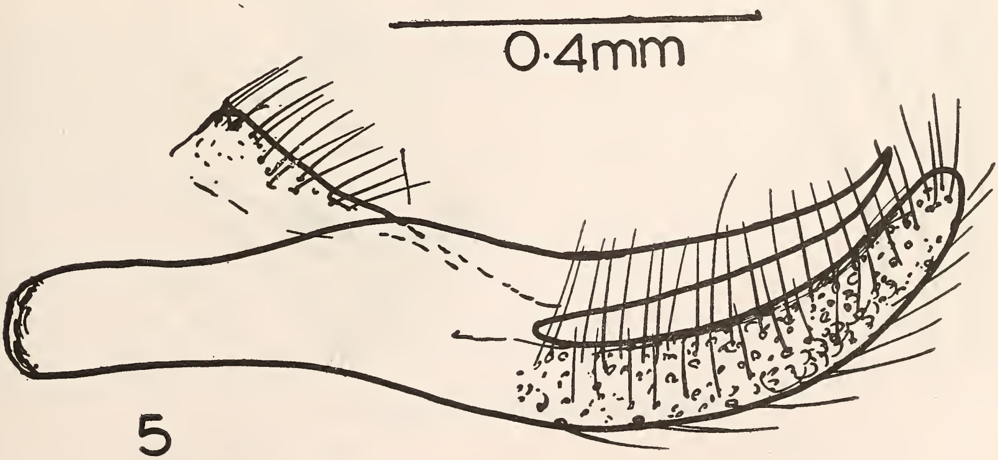

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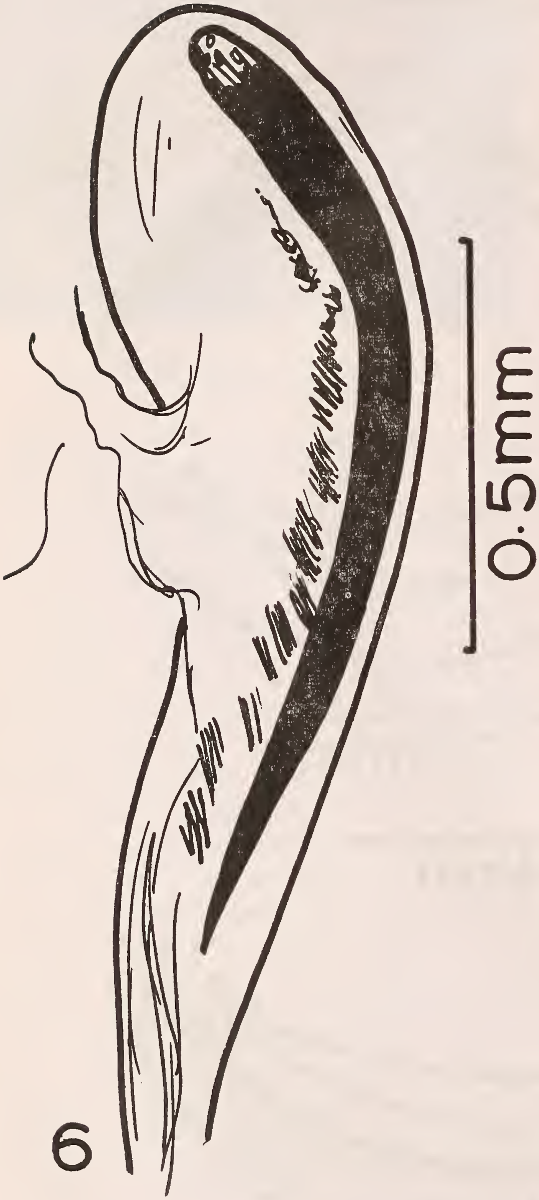
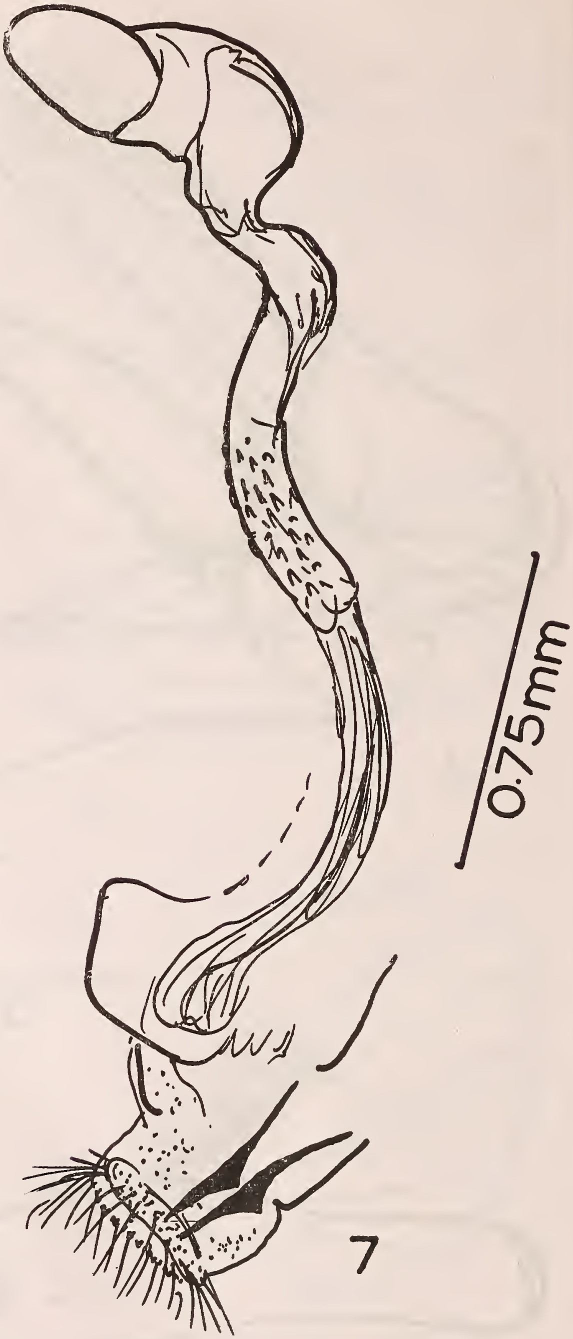
Nirmaladia dentilinealis (Hampson)
Fig. 4. Male genitalia with one valva and aedeagus removed. Fig. 5. Valva.





Nirmaladia dentilinealis (Hampson)

Fig. 6. Aedeagus.

Fig. 7. Female genitalia.

(Type-locality: India, Punjab)
(Figs. 1-7)

Labial palpus porrect, extending about thrice the length of head, thickly scaled. Maxillary palpus triangularly scaled. Frons rounded. Antenna of male thickened but without any serrations. Ocellus poorly developed. Fore-wing with vein R_1 free; R_2 free; R_3 stalked with R_4; R_5 arises from below upper angle of cell; M_1 absent; M_2 and M_3 stalked. Hind wing with Rs anastomosing with $Sc + R_1$; veins M_2 and M_3 stalked. Abdomen of the female tapering distally and without any prominent scales.

Male genitalia: Uncus moderately long, slender, tapering to apex, densely setose with anteriorly directed setae, extreme tip naked and without any hook; gnathos well developed, almost equal to uncus, strongly sclerotized; tegumen very long, with sides almost parallel and strongly sclerotized, without pons; vinculum produced anteriorly into an extremely rudimentary saccus. Valva of unique type, with basal half without any differentiation of costa and sacculus; distal half sharply and deeply bifurcated, its dorsal lobe slender and densely setose, ventral projection pointed and naked. Transtilla inconspicuous; juxta small and notched. Aedeagus long, rounded anteriorly (without any apical process), finely tapering towards distal end; vesica impregnated with a heavily sclerotized long cornutus and small patches of short setae below the curvature of cornutus.

Female genitalia: Corpus bursae relatively short, membranous with a few sclerotized lines; signum absent; ductus bursae long, semi-membranous, denticulate around the middle; anterior apophyses absent; posterior apophyses moderately long and thick, each with an angular thickening near base; ovipositor lobes broad and fringed with different sized setae.

Distribution: India and Nepal.

ACKNOWLEDGEMENTS

I wish to express my deep gratitude to Dr H. R. Pajni, Dept. of Zoology, Punjab University, Chandigarh, for his valuable suggestions during the course of preparation of this manuscript. Thanks are also due to Mr. I. J. Gupta, Lepidoptera Section, Zoological Survey of India, Calcutta for his comments on the identity of the species.

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JOURNAL, BOMBAY NATURAL HIST. SOCIETY, Vol. 80

FIRST RECORD OF *CLAUSENIA* ISHII (HYMENOPTERA: ENCYRTIDAE) FROM INDIA WITH DESCRIPTIONS OF TWO NEW SPECIES[1]

S. ADAM SHAFEE
AND
RAJENDRA KUMAR AVASTHI[2]

(*With a text-figure*)

Clausenia Ishii is reported for the first time from India. Two new species (*C. longipennis* sp. nov. and *C. indica* sp. nov.) are described and illustrated. Key to species of *Clausenia* is also provided. Types deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Genus *Clausenia* Ishii

Type-species: *Clausenia purpurea* Ishii, 1923 (by original designation and monotypy).

The genus *Clausenia* was first proposed by Ishii (1923) with *C. purpurea* Ishii as type-species. The generic characters of this genus have been given in detail by Kerrich (1967). Some additional generic characters are suggested which are as follows: Female genitalia, first valvifer (fig. 1 G) semicircular, second valvifers (fig. 1 F) very narrow at apical one-third; subgenital plate (fig. 1 E) with anterior margin concave, anterolateral apodemes long.

The genus *Clausenia* Ishii is reported for the first time from India. Two species are described here as new. Kerrich's (1967) key to species of *Clausenia* Ishii has been revised in order to accommodate *C. indica* sp. nov. and *C. longipennis* sp. nov.

REVISED KEY TO SPECIES OF *Clausenia* ISHII, BASED ON FEMALES

1. Abdomen not much shorter than thorax; subgenital plate (=hypopygium) boat-shaped, pointed at apex 2
— Abdomen much shorter than thorax; subgenital plate (=hypopygium) semitruncated and notched in the middle, scarcely boat-shaped; antennal club with second suture not strongly curved or oblique; frontovertex shining, with reticulate microsculpture very fine and punctation sparse: Africa . . . . *C. confusor* Kerrich
2. Antennae having funicle segments 5 and 6 only a little longer than broad.................. 3
— Antennae having 6th funicle segment about one and a half times as long as broad and 5th still longer 5
3. Mesoscutum less densely punctate; marginal vein of fore wing almost twice length of stigmal vein; head not dominantly dark green............ 4
— Mesoscutum more densely punctate; marginal vein of fore wing only moderately longer than stigmal vein; head usually dominantly dark green: Asia, U.S.A................. *C. purpurea* Ishii
4. Postmarginal vein distinctly longer than marginal vein; legs with coxae and trochanters except at apex, and femora except at base and apex, pale blackish brown with weak, mostly purplish, metallic reflections; mesoscutum with setigerous puncts separated by about twice their own diameters: West Africa....... *C. corrugata* Kerrich
— Postmarginal vein distinctly shorter than marginal vein (fig. 1 K); legs orange yellow; mesoscutum with setigerous puncts separated by more than four times their own diameters: India.... .... *C. indica* sp. nov.
5. Fore wings with marginal vein less than twice the length of stigmal vein; eyes moderately setose 6
— Fore wings with marginal vein almost twice as long as stigmal vein; eyes weakly setose....... 7
6. Fore wings broad, about twice as long as wide.

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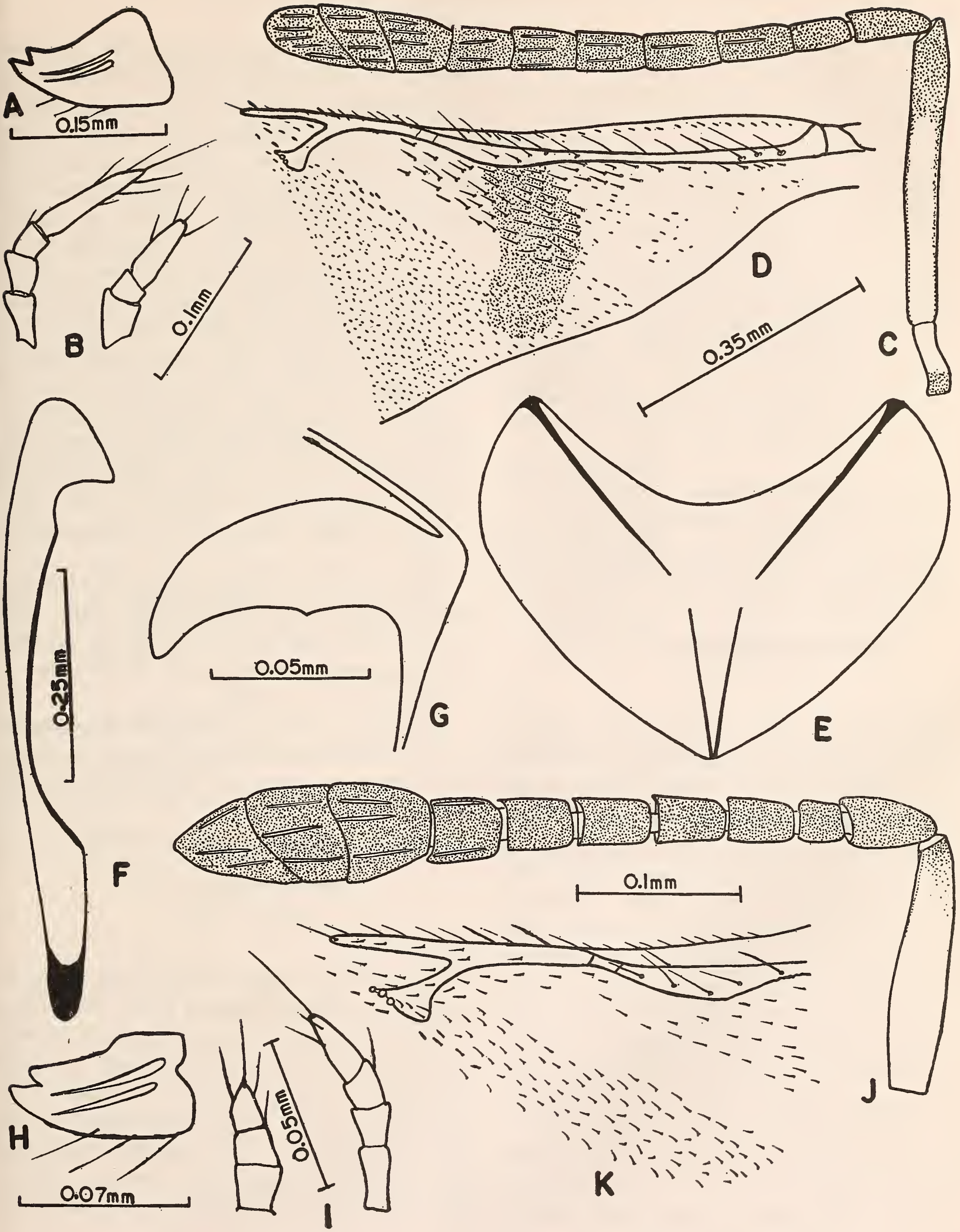
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Fig. 1. A-G. *Clausenia longipennis* sp. nov., ♀: A. Mandible; B. Maxillary and labial palpi; C. Antenna; D. Part of fore wing; E. Subgenital plate; F. Second valvifer; G. First valvifer. H.-K. *Clausenia indica* sp. nov., ♀: H. Mandible; I. Maxillary and labial palpi; J. Antenna; K. Part of fore wing venation.

disc proximal to speculum with thin setae beneath submarginal vein (Rosen, 1965: fig. 6); antennae with first funicle segment slightly longer than wide (Rosen, 1965: fig. 4): Israel..*C. josefi* Rosen

— Fore wings moderately narrow, more than two and a half times longer than wide, disc proximal to speculum with numerous coarse setae beneath submarginal vein (fig. 1 D); antennae with first funicle segment twice as long as wide (fig. 1 C): India...................*C. longipennis* sp. nov.

7. Head in side view (Kerrich, 1967: fig. 42) with cheeks not sharply narrowed to mouth; punctures on mesoscutum not very fine, many separated by less than twice their own diameters; hind tibiae usually mainly pale, darkened above, but if more extensively darkened then at least broadly pale at apex: West Africa.....................................*C. quineensis* Kerrich

— Head in side view (Kerrich, 1967: fig. 41) with cheeks rather sharply narrowed to mouth; punctures on mesoscutum very fine, mostly separated by well over twice their own diameters; hind tibia only rather narrowly pale at apex: South Africa, Eritrea ....*C. comperei* Kerrich

Clausenia longipennis sp. nov.

(Fig. 1 A-G)

FEMALE:

Head.—Dark, slightly wider than long in facial view; antennae inserted below lower level of eyes; space between antennal sockets about one-third width of frons between eyes; malar space shorter than eye width; eyes moderately setose; maxillary and labial palpi (fig. 1B) 4- and 3-segmented respectively; mandibles (fig. 1A) bidentate. Antennae (fig. 1C) dark brown except basal three-fourth of scape orange yellow; scape long and slender, about 8 times as long as wide; pedicel distinctly longer than 1st funicle segment; funicle segment 1st shortest, 2nd and 3rd subequal in length and each about twice as long as wide, 5th and 6th one and a half times as long as wide; club 3-segmented, as long as preceding 3 funicle segments together.

Thorax.—Dark brown; mesoscutum coarsely setose and with distinct parapsidal furrows anteriorly, axillae and scutellum finely setose and reticulately sculptured. Fore wings slightly infuscated, about two and a half times as long as wide; disc proximal to speculum with numerous coarse setae beneath the submarginal vein; submarginal vein slightly widened at apical third; marginal vein slightly longer than postmarginal vein and less than twice the length of stigmal vein (fig. 1D); marginal fringe small, spaced by a distance equal to one-fourth their length. Hind wings hyaline, about five and a half times as long as wide (1.01:0.19 mm); marginal fringe small, spaced by a distance equal to one-fourth their length. Legs dark brown except fore and mid tibiae at apical halves, hind tibiae completely, and tarsi yellowish; middle tibial spur as long as basitarsus.

Abdomen.—Dark, slightly longer than thorax; tenth tergum long; paratergites long and narrow; subgenital plate boat-shaped, pointed at apex, reaching beyond apex of abdomen.

Body length: 1.6 mm.

Holotype ♀. INDIA: Uttar Pradesh, Aligarh, ex. *Coccidohystrix insolitus* (Green), on *Solanum melongena* L., 2. viii. 1977 Coll. S. Adam Shafee.

Paratypes. ♀, same data as holotype.

Clausenia indica sp. nov.

(Fig. 1 H-K)

FEMALE.

Head.—Dark, slightly wider than long in facial view; antennae inserted below lower level of eyes; eyes dark brown and sparsely setose; space between antennal sockets about one-half the width of frons between eyes; maxillary and labial palpi (fig. 1I) 4 and 3-segmented respectively; mandibles (fig. 1H) bidentate. Antennae (fig. 1J) dark except scape orange yellow; scape four and a half times longer than wide, pedicel about twice the length of first funicle segment, first funicle segment shortest and slightly longer than wide; funicle segments 2-6 subequal in length, 2-4 one and a half times as long as long as wide, 5th slightly longer than wide, 6th as long as wide; club 3-segmented, slightly longer than preceding three funicle segments combined.

Thorax.—Dark and recticulately sculptured with setigerous puncts sparsely distributed and separated by more than four times their own diameters; mesoscutum with parasidal furrows as in *C. purpurea* Ishii (Rosen, 1965: fig. 16); axillae triangular, meeting medially. Fore wings hyaline, about two and a half times as long as wide; submarginal vein long, slightly dilated at apical third, marginal vein slightly longer than postmarginal and twice the length of stigmal vein (fig. 1K); marginal fringe small, spaced by a distance equal to one-third their length. Hind wings hyaline about five and a half times longer than wide; marginal fringe small, spaced by a distance equal to one-fourth their length. Legs uniformly orange yellow; middle tibial spur as long as basitarsus.

Abdomen.—Dark brown, as long as thorax; subgenital plate boat-shaped, reaching slightly beyond apex of abdomen.

Body length: 1.2 mm.

Holotype ♀, INDIA: Tamil Nadu, Coimbatore, ex. *Rastrococcus* sp. on *Acacia moniliformis*, 27. iii. 1979. Coll. R. K. Avasthi.

ACKNOWLEDGEMENTS

We are deeply indebted to Prof. Nawab H. Khan, Head, Department of Zoology, for providing research facilities. Thanks are also due to Prof. S. Mashhood Alam for encouragement. One of us (R. K. Avasthi) is grateful to C.S.I.R, New Delhi, for financial assistance.

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A NEW SPECIES OF *PARABLASTOTHRIX* (HYMENOPTERA: ENCYRTIDAE) FROM INDIA[1]

M. A. KHAN[2]

(*With seven text-figures*)

Parablastothrix Mercet 1917

The genus *Parablastothrix* was erected by Mercet (1917) for the Palaearctic species *P. vespertinus.* Hoffer (1960) considered *Matrella* Erdos as synonym of *Parablastothrix* Mercet. Miller (1965) has given a very good diagnostic key for its separation from the closely related genus *Tetracnemus* Westw. Shafee *et al.* (1973) recorded the genus for the first time from India, represented by *P. indicus* Shafee *et al.*

So far only one species of the genus is known from India. A new species has been described and key to species of *Parablastothrix* Mercet has also been proposed.

KEY TO THE SPECIES OF *Parablastothrix* MERCET

1. Body black or bright, metallic, greenish-blue.. 2

— Body blue; mid legs white with base of femur,

2. Body black; front and mid legs and coxa, femur & tarsus of hind leg white; integument of head finely, densely punctate with widely scattered large punctures. ....*P. nearcticus* Miller.

— Body blue; mid legs white with base of femur, tibia and last tarsal segment dark; hind leg with coxa bluish, femur blackish with white apex, tibiae darkish, tarsus white; integument of head finely and densely shagreened, the shagreening becoming rugose.......*P. vespertinus* Mercet.

3. Ocelli arranged in obtuse angle triangle; antennae uniformly dark brown; club two times longer than wide; marginal vein as long as Post marginal vein; abdomen yellowish brown with slight metallic reflections.......*P. indicus* Shafee *et al.*

— Ocelli arranged in equilateral angle triangle, antenna dark brown with funicle segments 5th, 6th and club white; club less than three times longer than wide; marginal vein longer than post marginal vein; abdomen dark brown. .... *P. zygonomus* sp. nov.

Parablastothrix zygonomus sp. nov.

MALE:

Head (Fig. 1): Dark brown with metallic bluish reflections, wider than long in facial view; frontovertex reticulate punctate with silvery setae, less than twice longer than wide (0.14:0.08) and more than one third of head width (0.08:0.26); ocelli arranged in equilateral angle triangle, basal ocellus separated by less than its own diameter from eye rim and two times its diameter from occipital margin; eyes black; mandibles tridentate (Fig. 2), maxillary (Fig. 3) and labial (Fig. 4) palps 4 and 3 segmented respectively.

Antennae (Fig. 5): Dark brown with funicle segment 5th, 6th and club white, scape dialated, more than three times longer than wide (0.19:0.06); pedicel as long as wide (0.06: 0.06), distinctly longer than first funicle segment, funicle segments 1-4 with branches, funicle segments longer than wide except first which is wider than long, third funicle segment as long as basal two funicle segments united, 4th funicle segment as long as 5th and 6th less than twice as long as 5th funicle segment; club less than three times as long as wide (0.15:0.055), distinctly shorter than preceding two funicle segments combined.

Thorax (Fig. 6): Dark brown with metallic bluish reflections, scutum twice wider than long (0.24:0.12); axillae narrowly united; scutellum

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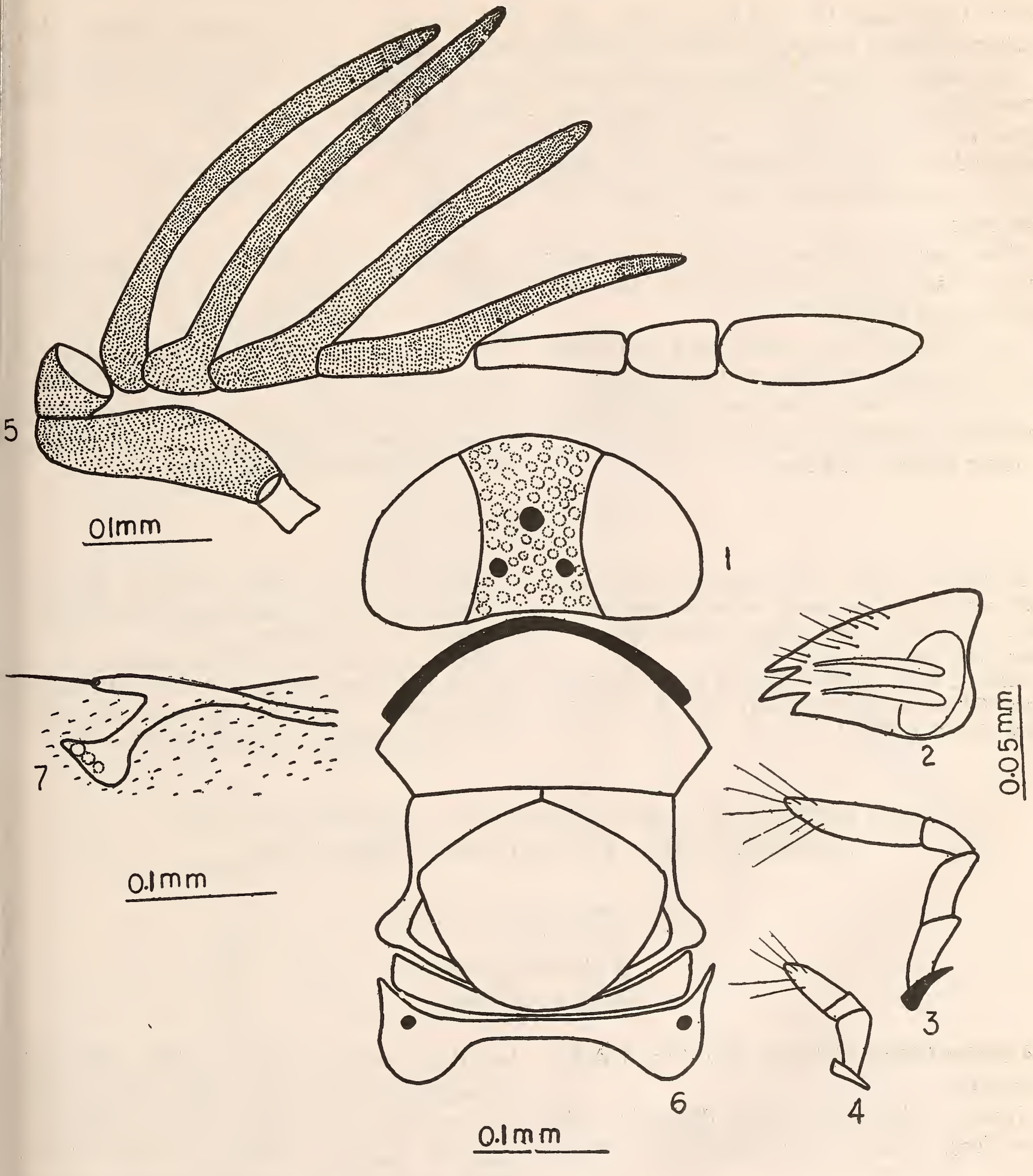
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Figs. 1-7. *Parablastothrix zygonomus* sp. nov., ♂
1. Head, dorsal aspect; 2. Mandible; 3. Maxillary palp; 4. Labial palp; 5. Antenna; 6. Thorax; 7. Part of fore wing venation.

wider than long (0.19:0.17), longer than scutum, posterior margin of scutellum rounded.

Fore wings: Hyaline, slightly more than two times longer than wide; costal cell broad, marginal vein (0.07) (Fig. 7) longer than postmarginal vein (0.05), stigmal vein very long (0.09), speculum absent, basal triangle with few setae.

Hind wings: Hyaline, less than four times longer than wide, apex of marginal vein with three curved hooklets.

Legs: Dark brown, except apex of femora, bases and apices of tibiae and tarsi white.

Abdomen: Dark brown with slight metallic reflections, slightly shorter than thorax.

Male length: 0.95 mm.

Holotype: ♂, 1♂ paratype, India, U.P. Pantnagar Ex. Leaf miner *Acrocercops zygonoma* (Lepidoptera: Gracillaridae) on wild plant 3.7.1978 (M. A. Khan).

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DESCRIPTION OF A NEW SPECIES OF *ANICETUS* HOWARD (HYMENOPTERA: ENCYRTIDAE) FROM INDIA[1]

RAJENDRA KUMAR AVASTHI
AND
S. ADAM SHAFEE[2]

(*With a text-figure*)

Anicetus tibimaculatus sp. nov. (Fig. 1 A-F)

FEMALE:

Head.— Yellowish brown, distinctly wider than long in facial view; frontovertex slightly less than twice as long as wide; ocelli red, arranged in equilateral triangle, lateral ocelli less than their own diameters from orbital and occipital margins; antennae inserted below lower level of eyes; space between antennal sockets as long as the width of frons between eyes; malar space slightly shorter than

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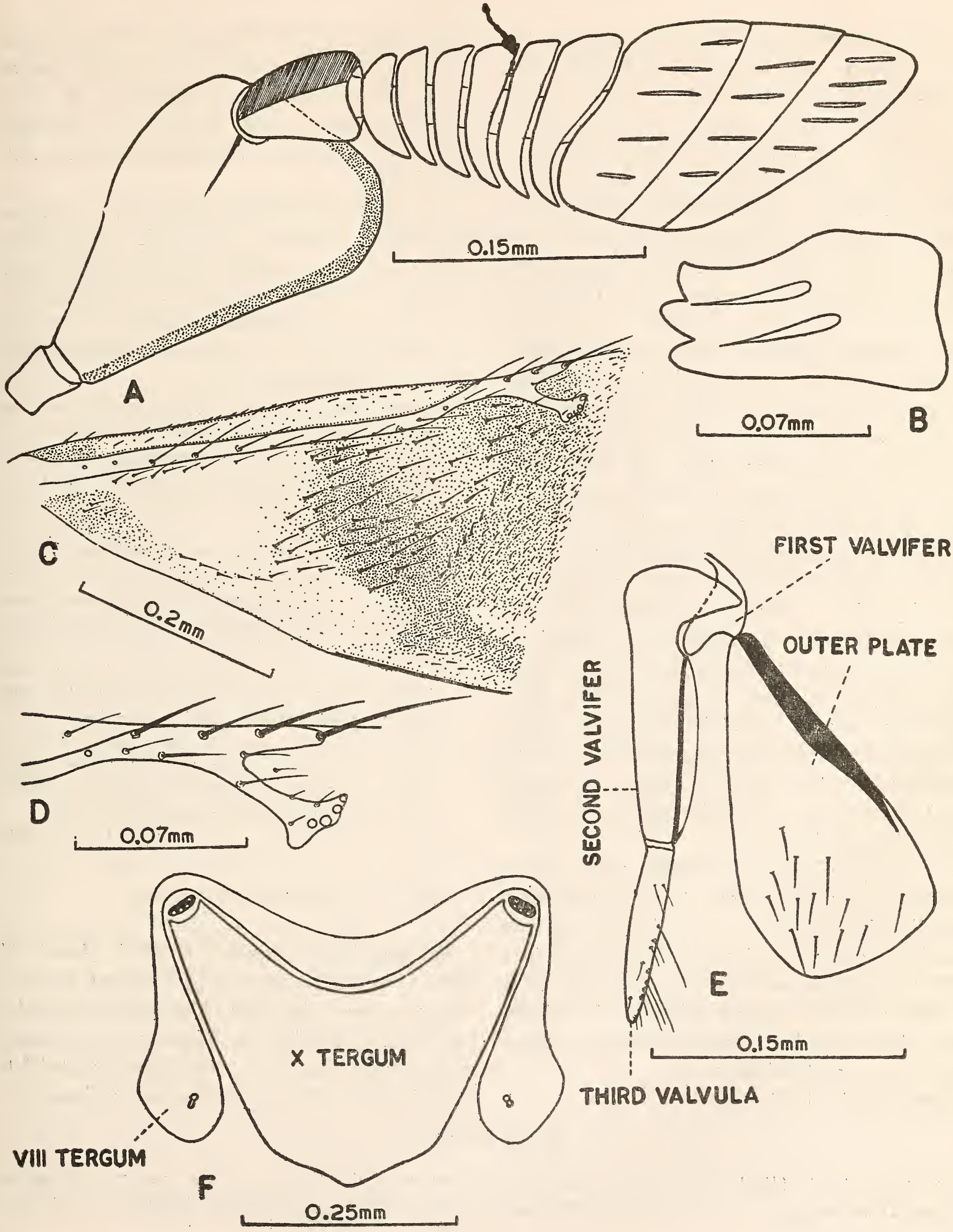
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THIRD VALVULA
X TERGUM
8
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VIII TERGUM
F
0.25mm

Fig. 1. A.-F. *Anicetus tibimaculatus* sp. nov., ♀: A. Antenna; B. Mandible; C. Part of fore wing; D. Part of fore wing venation; E. Part of external genitalia; F. Apex of abdomen in dorsal view.

eye width; malar sutures absent; maxillary and labial palpi 4- and 3-segmented respectively; mandibles (fig. 1B) tridentate. Antennae (fig. 1A) yellowish brown, except inner margin of scape dark; scape much flattened, distinctly longer than wide; pedicel much longer than wide with dorsal edge flattened; funicle flattened, 6-segmented, gradually increasing in width distad; club flattened, 3-segmented, greatest length distinctly longer than funicle.

Thorax.— Yellowish brown; mesoscutum entire, densely setose and about twice as wide as long; scutellum distinctly wider than long and with 30 setae, apex triangular; mesopostphragma well developed, reaching beyond the propodeum. Fore wings (fig. 1C) infuscated except a triangular area at base hyaline, two and a half times as long as wide; costal cell well developed, marginal vein as long as stigmal and distinctly longer than postmarginal vein (fig. 1D); speculum proximally with 50 coarse setae; marginal fringe short, spaced by a distance equal to one-third their length. Hind wings hyaline, four times as long as wide; marginal fringe short, spaced by a distance equal to one-third their length. Legs yellowish, except hind legs with two bands on tibiae and basal apical tarsal segments dark brown; middle tibial spur as long as basitarsus.

Abdomen.— Yellowish, slightly shorter than thorax; paratergites absent (fig. 1F); Female genitalia (fig. 1E): ovipositor hidden, arising from basal one-third of abdominal venter, first valvifers triangular with basal and apical angles at different levels, second valvifers of uniform width, third valvulae long and movably articulated with second valvifers.

Body length: 1.33 mm

Holotype ♀; 3♀♀ paratypes, INDIA: Tamil Nadu, Coimbatore, ex. *Ceroplastodes cajani* (Maskell), on *Abutilon indicum*, 27. iii. 1979 (*R. K. Avasthi*). Types deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

In the key to species-groups of *Anicetus* proposed by Annecke (1967), the new species comes under the group *Anicetus abyssinicus* Annecke. Annecke's (1967) key to the species in the group of *Anicetus abyssinicus* Annecke has been revised in order to accommodate *Anicetus tibimaculatus* sp. nov.

REVISED KEY TO SPECIES IN THE GROUP OF *Anicetus abyssinicus* ANNECKE, BASED ON FEMALES

1. Marginal vein slightly longer than stigmal and about twice the length of postmarginal vein; base of fore wing proximal to speculum with 30 or less coarse setae 2

— Marginal vein as long as stigmal and slightly longer than postmarginal vein; base of fore wing proximal to speculum with about 50 coarse setae; ocelli arranged in equilateral triangle; hind tibiae with two infuscated bands....................................... *A. tibimaculatus* sp. nov.

2. Ocelli in a right angle; middle and hind tibia each with two well-marked brown bands............................ *A. abyssinicus* Annecke

— Ocelli in a strongly acute-angled triangle; middle tibia not marked with spots or bands, hind tibia with two brown spots or incomplete bands............................ *A. deltoideus* Annecke

ACKNOWLEDGEMENTS

We are deeply indebted to Prof. Nawab H. Khan, Head, Department of Zoology, for providing research facilities. Thanks are also due to Prof. S. Mashhood Alam, for encouragement. One of us (R. K. Avasthi) is grateful to C.S.I.R., New Delhi, for financial assistance.

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A NEW SPECIES OF *TETRASTICHUS* (HYMENOPTERA: EULOPHIDAE) FROM INDIA[1-2]

M. A. Khan[3]

(*With eleven text-figures*)

Tetrastichus Haliday 1843

Genotype: *Cirrospilus attatus* Walker by original designation [= *miser* (Nees)].

The genus *Tetrastichus* Haliday is a useful member of the Chalcidoidea which attacks a wide variety of hosts, including important pests of agriculture crops such as caterpillars, stemborers, leaf miners, aphids, beetles, midges and thrips. The parasites attack different stages of the host including eggs, larvae, nymphs and pupae. They are either primary parasites or hyperparasites. Some of the species of *Tetrastichus* have also been reared as secondary parasites. The species described here has been reared as a secondary parasite upon cocoons of *Apanteles* sp. (Hymenoptera: Braconidae) on the larvae of Bihar hairy caterpillar, *Diacrisia obliqua* Walker (Lepidoptera: Arctiidae).

The genus has been revised by Burks (1943) and the generic characters proposed by him apply well to this species.

Tetrastichus pantnagarensis sp. nov.

FEMALE:

Head: Brownish with yellowish reflections, reticulate sculpture, wider than long in frontal aspect (0.6:0.48) (Fig. 1), width of frons between eyes less than twice the width of head, frontovertex wide (0.35), sparsely setose, ocelli arranged in obtuse angle triangle, basal ocelli removed from eye rim by almost twice the diameter of an ocellus; eyes setose; distance between antennal sockets less than one sixth width of frontovertex at median ocellus, antennal sockets with their basal margin well above the level of the basal ocular line, distance between antennal sockets and eye twice the distance between two antennal sockets; malar space shorter than eye length, subocular suture distinct; mandibles tridentate with two teeth and a truncation (Fig. 2), maxillary (Fig. 3), and labial palpi (Fig. 4) one segmented.

Antennae (Fig. 5): Uniformly brown except scape yellowish, sparsely setose, scape cylindrical, more than three times longer than wide (0.16:0.05), pedicel twice as long as wide (0.09:0.045), funicle with a ring, segments elongated, first funicle segment very long (0.14:0.05), 2nd and third segment subequal in size (0.11:0.06), club three segmented, three times longer than wide (0.21:0.07), shorter than preceding two funicle segments united; first funicle to last club segment with 9,10,12,12,10 and 5 sensoria respectively.

Thorax (Fig. 7): Brown with yellowish reflections, with fine reticulate sculpture, pronotum (Fig. 6) wide with a notch in the middle of anterior margin, posterior margin convex with 16 setae, scutum convex with longitudinally fine striate, wider than long (0.4:0.27) with a median groove, seven small setae at each lateral side of the scutum, scutellum shorter than the scutum, with distinct longitudinal grooves and with two pairs of strong setae; postscutellum, slightly shorter than the propodaeum measured in the middle; mesopostphragma long, notched at apex.

Fore Wings (Fig. 8): Hyaline, twice as long

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[2] Research paper No. 2213 through the Experiment Station, G.B.P.U.A. and T., Pantnagar, Nainital, U.P., India.

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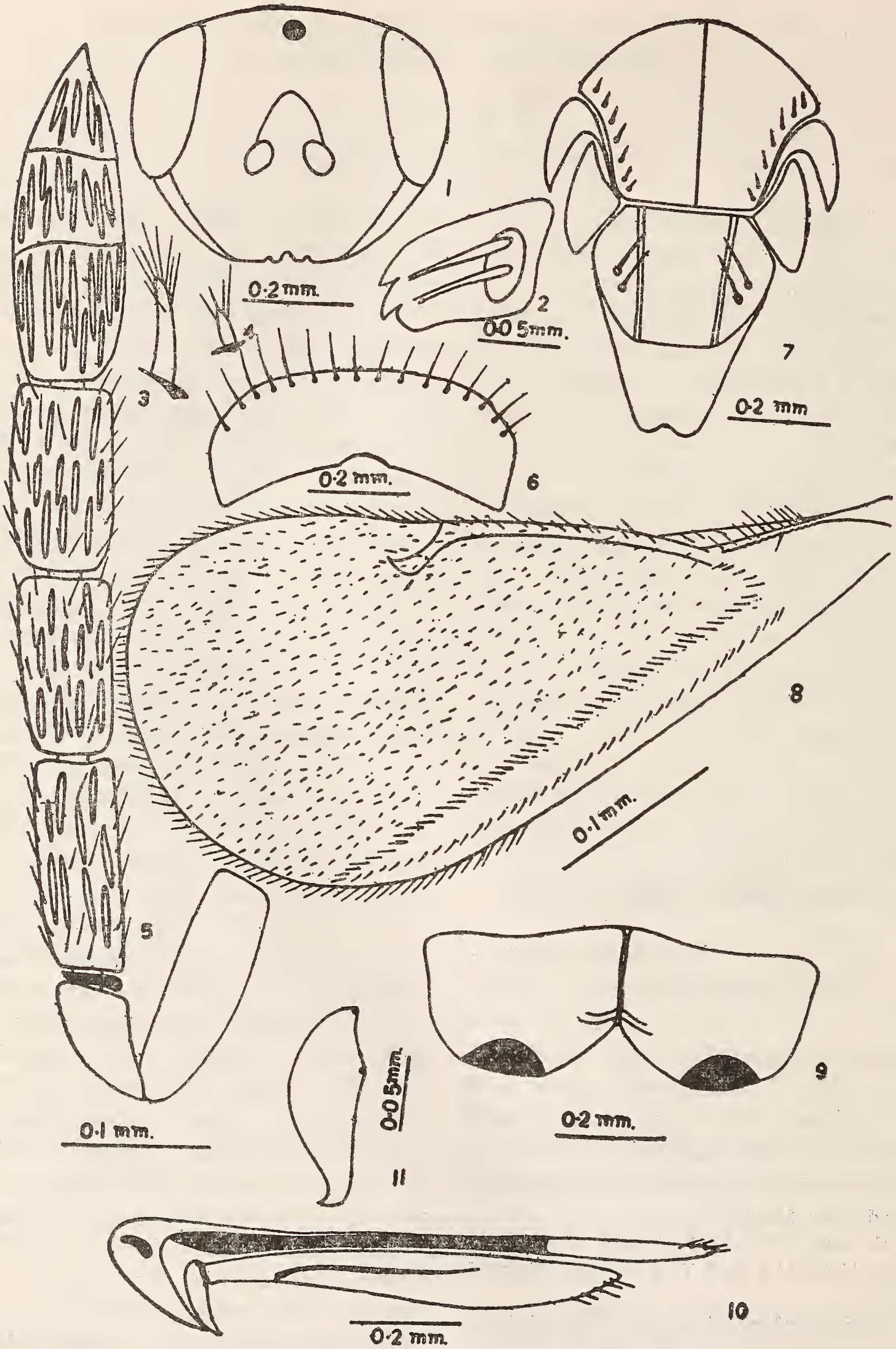
1
0·2 mm.
2
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4
7
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8
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0·1 mm.
0·05mm.
11
9
0·2 mm.
10
0·2 mm.

Figs. 1-11. *Tetrastichus pantnagarensis* sp. nov., ♀
1. Head, frontal aspect; 2. Mandible; 3. Maxillary palp; 4. Labial palp; 5. Antenna; 6. Pronotum; 7. Thorax; 8. Forewing; 9. Subgenital plate; 10. Ovipositor; 11. First valvifer.

as wide, costal cell narrow with three distinct setae, submarginal vein with 10 setae, postmarginal vein wanting, stigmal vein (0.04) almost one third length of marginal vein (0.11), marginal fringe short.

Hind Wings: Almost four times longer than wide, apex of marginal vein with three hooklets, marginal fringe long, spaced by a distance almost equal to one fifth length of a fringe.

Fore Legs: Coxae, trochanter and almost three fourth of the tibiae dark brownish, rest of the leg yellowish, femora compressed.

Middle Legs: Coloration same as of forelegs except the last tarsal segment brown; tibial spur short, apical rim of tibial with 3 short pegs.

Hind Legs: Coloration same as of fore legs except the last tarsal segment brown, two long setae on outer face of the base of coxae, femora much compressed, tibial spur short.

Abdomen: Brown with yellowish reflections, triangular, longer than thorax; subgenital plate (Fig. 9) with anterior margin concave in the middle, the central notch of its posterior margin with laterally directed ridges; outer plates of ovipositor with a ridge in the middle (Fig. 10), first valvifers (Fig. 11) semicircular with articular knobs prominent, second valvifers (Fig. 10) thickened on dorsal margin through out, third valvulae long, lanceolate (Fig. 10), movably articulated with second valvifers; ovipositor slightly exserted.

Female Length: 1.51 mm.

Male : Not known.

Holotype ♀, India, U.P., Nainital, Pantnagar, 10-4-1979, emerged from the cocoons of *Apanteles* sp. (Hymenoptera: Braconidae) on the larvae of *Diacrisia obliqua* (Walker) on sugarbeet (R. C. Chibber), Cat. No. Eulo. 1004.

Paratype 8 ♀ ♀ same data as holotype, Cat. No. Eulo. 1005. Material will be deposited in the Zoological Survey of India, Calcutta.

Tetrastichus pantnagarensis sp. nov. resembles *Tetrastichus inferens* Yoshimoto, 1970 from which it can be distinguished as follows:

Tetrastichus inferens Yoshimoto	*Tetrastichus pantnagarensis* sp. nov.
i) Body dark brown or black with slight blue green iridescence	i) Brownish with yellowish reflections
ii) Head slightly broader than mesonotum	ii) Head distinctly broader than mesonotum
iii) Malar space about 1/3 height of compound eye	iii) Malar space not so, but slightly shorter than height of compound eye
iv) Mandibles sharply bidentate	iv) Mandibles tridentate with two teeth and a truncation
v) Scape less than five times longer than wide, pedicel very long, longer than first funicle segment, funicle segments gradually broadening apically, club slightly more than twice longer than wide, longer than preceding two funicle segments combined.	v) Scape three times longer than wide, pedicel very short slightly more than half the length of first funicle segment, funicle segments elongated, first funicle segment very long, second and third segment subequal in size, club three times longer than wide, shorter than preceding two funicle segments combined.
vi) Scutum with three pairs of adnotaular bristles	vi) Scutum with seven pairs of adnotaular bristles
vii) Stigmal vein about one-fifth length of marginal vein.	vii) Stigmal vein almost one-third length of marginal vein.

ACKNOWLEDGEMENTS

I am thankful to Prof. K. C. Sharma, Dean, College of Agriculture, Prof. B. P. Pandya, Director Research, Experiment Station and Prof. B. P. Khare, Head, Department of Entomology for providing the necessary facilities. Thanks are also due to Mr. R. C. Chibber for providing the specimens for identification.

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ON A NEW SPECIES OF GENUS *ASPIDOMYCTER* MARSHALL (COLEOPTERA: CURCULIONIDAE: EREMNINAE) FROM INDIA[1]

H. R. PAJNI AND C. S. SIDHU[2]

(*With six text-figures*)

A new species, *A. laesicollis* has been described under genus *Aspidomycter* Marshall. A key to the three so far known Indian species in this genus has been included and the characters of the genus have been elaborated. The structure of the male and female genitalia of *A. lunatus* Marshall has also been included.

INTRODUCTION

We have studied more than one hundred species of subfamily Eremninae during the course of a five year U.S. PL-480 project on Indian Curculionidae. As many as 49 new species and 9 new genera have been proposed under this subfamily. The present communication deals with a new species of genus *Aspidomycter* Marshall.

The genus *Aspidomycter* was raised by Marshall (1943) on a type species, *A. lunatus.* He also described a new sub-species namely *A. lunatus lefroyi* to which he later on (Marshall 1944) accorded the status of a valid species. The present new species thus marks the record of a third species under the same genus. Keeping in view the current knowledge on the genus *Aspidomycter*, the characterization of this genus has been revised and a key to all the three Indian species has been given. The structure of the male and female genitalia of *A. lunatus* Marshall, also studied by us, has been included.

RESULTS AND DISCUSSION

Genus *Aspidomycter* Marshall

Marshall, Ann. Mag. Nat. Hist. (11) *10*, p. 108 (1943): (11) *11*, pp. 77, 81 (1944).

Head with dorsal area of rostrum broadly ascending its anterior part, and terminated posteriorly by a deeply impressed transverse line; eyes circular, somewhat convex. Rostrum very broad, dorsal area elevated and without any median sulcus or carina; epistome elongate, its margins carinate and forming an acute angle behind; scrobes short, curving inwards, suddenly effaced behind; mentum with four setae. Antennae with scape curved, gradually clavate;

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[1] Accepted March 1982.

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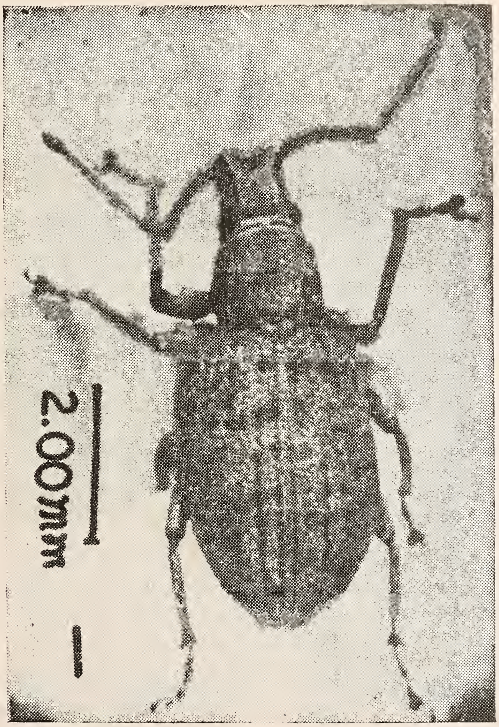
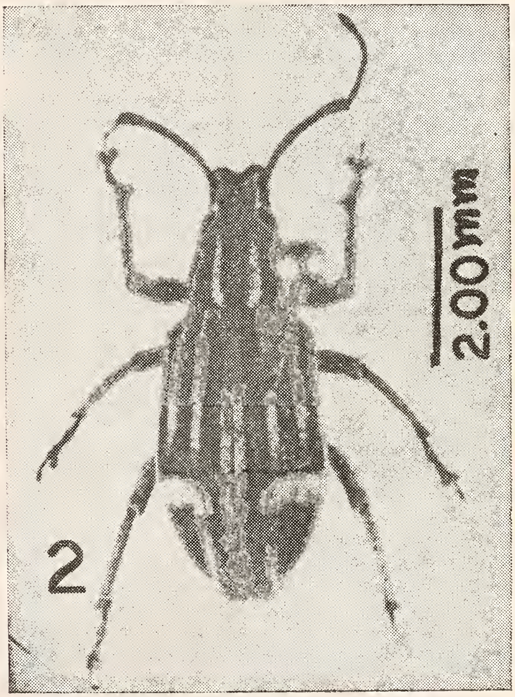
funicle with joint 2 longer than 1. Prothorax deeply bisinuate at base, its ocular lobes feeble or moderate, with obliquely prominent shoulders. Legs with corbels of hind tibiae fully enclosed, each having two rows of setae on external edge. Male genitalia with aedeagus sinuate at apex, there produced into a process in middle in which lies exophallic valve, orificial plates prominent, aedeagal apodemes more than twice as long as aedeagus. Female genitalia with bursa copulatrix sclerotized towards apex.

Type species: *Aspidomycter lunatus* Marshall

Aspidomycter laesicollis sp. nov.
(Figs. 1, 3, 5)

Head with frons ferrugineous, covered with shining blue-green and brownish scales and some greenish sub-erect setae, only slightly wider than base of rostrum and separated from it by an incision; eyes black, somewhat convex, moderately large and circular. Rostrum ferrugineous, almost as long as broad, running parallel from base to scrobes and only slightly dilated at apex, posteriorly ascending frons to form a raised plate, broadly truncate at base, almost flat and shallowly depressed behind the epistome and there provided with a fine central carina; surface of rostrum covered with shining blue-green and brownish scales and short spathulate pale setae, area close to epistome bare; epistome long, with its delimiting carinae high and forming and acute angle behind; scrobes short, broad, open behind, almost





1. Photograph of Adult *Aspidomycter laesicollis* sp. nov.
2. Photograph of Adult *A. lunatus* Marshall.

visible from above; mentum with 4 setae. Antennae ferrugineous, long; scape stout, curved, gradually clavate, reaching three-fourth of prothorax, its surface densely covered with brownish-green scales and sub-recumbent pale setae; funicle with second joint 1.3 times as long as first, third and fourth subequal but shorter than first, fourth to seventh subequal

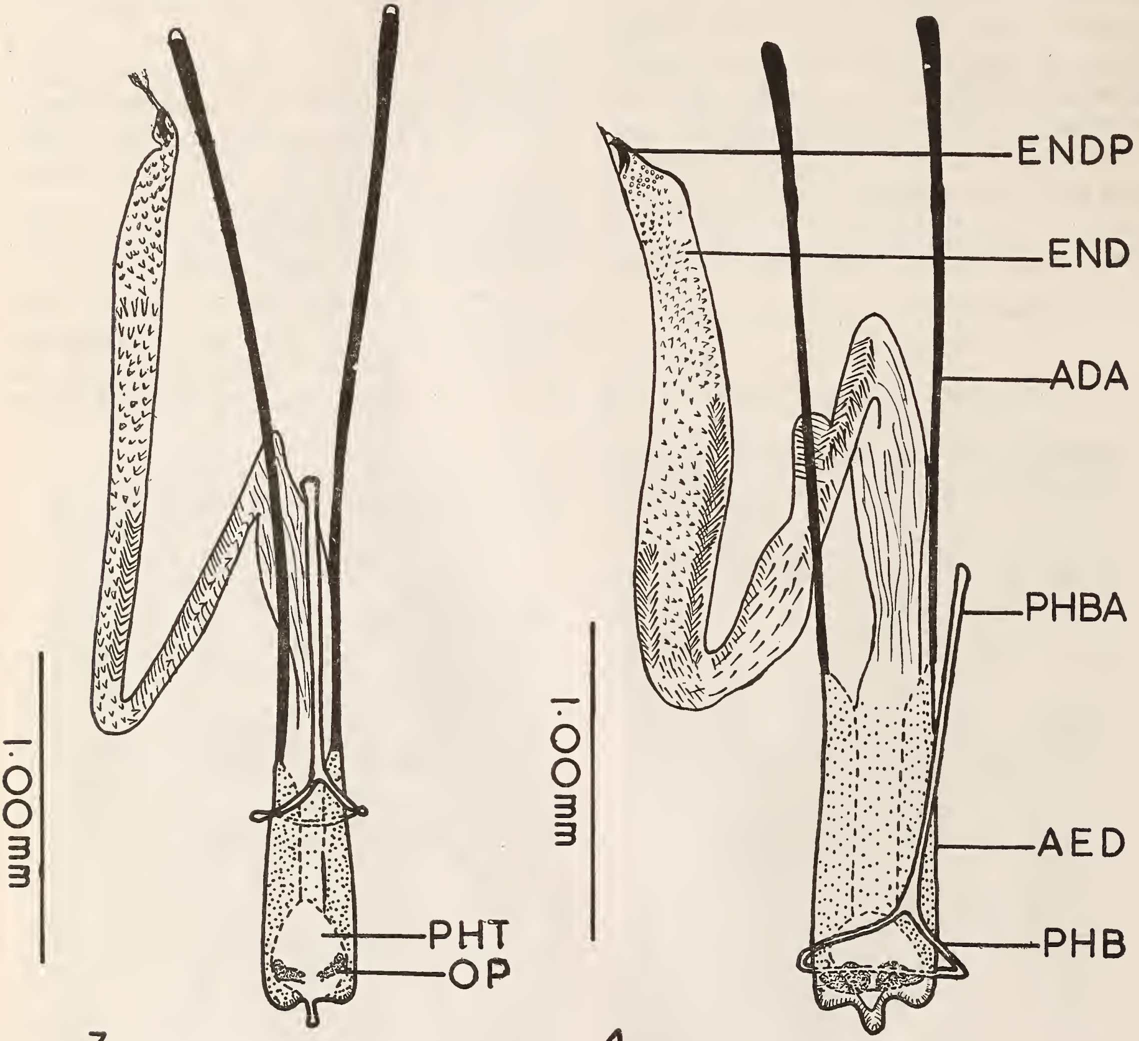


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Fig. 3. Male genitalia of *A. laesicollis* sp. nov.
Fig. 4. Male genitalia of *A. lunatus* Marshall.

Abbreviations

ADA, Aedeagal Apodeme; AED, Aedeagus; END, Endophallus; ENDP, Endophallic plate; OP, Orificial plate; PHB, Phallobase; PHBA, Phallobasic apodeme; PHT, Phallotreme.

and shortest, all joints covered with brownish-green scales and sub-recumbent pale setae; club dark brown, fusiform, finely and uniformly pubescent.

Prothorax ferrugineous, as long as broad, its anterior margin arcuate dorsally, with feeble ocular lobes and fine vibrissae laterally; dorsal surface of pronotum marked with small dense punctures; each puncture having a pale, sub-recumbent and spathulate seta; surface also furnished with blue-green scales, with a central and two dorso-lateral indistinct longitudinal stripes of brown scales, also with two deep and broad depressions near basal angles on brown stripes; lateral sides almost straight, about as broad at apex as at deeply bisinuate base, narrowly constricted near base. Scutellum small, rectangular, with anterior margin rounded, completely covered with blue-green scales. Elytra ferrugineous, oblong, their dorsal outline convex, running parallel from base to behind middle in male and widening in female, shoulders prominent and roundly rectangular; striae narrow, formed by small deep punctures, each puncture containing a minute recumbent seta; intervals broad, flat, covered with shining blue-green scales, with some scattered spots of dark-brown scales, each interval with numerous short and pale setae with long erect ones on and near top of declivity.

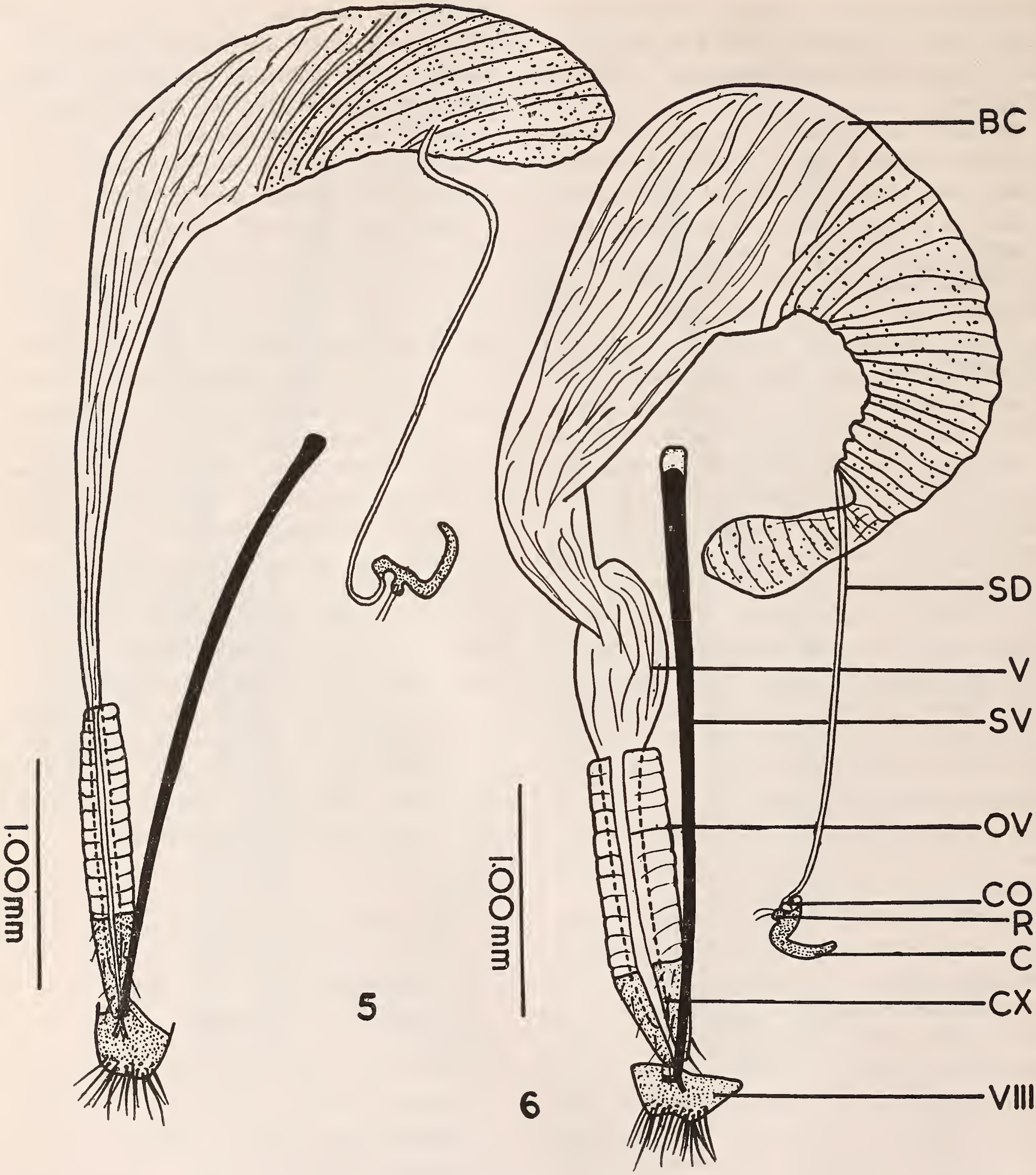
Legs ferrugineous, covered densely with blue-green and brownish scales, and small recumbent setae; forecoxae contiguous, placed a little towards anterior margin of prosternum; femora clavate, each with a sharp tooth; tibiae slender, each with a fringe of brownish bristles and a mucro at apex; anterior and middle tibiae with a row of spines on inner apical halves, corbels of hind tibiae enclosed, each with an outer row of short and an inner row of long bristles. Tarsi densely setose; hind tarsus with first joint nearly twice as long as second, third bilobed joint spongy beneath; claws free. Thoracic sterna ferrugineous, covered with blue-green and pale scales, punctate and each puncture with a pale seta. Abdominal sterna ferrugineous, covered with blue-green scales laterally and with narrow pale scales in the middle, punctate and each puncture with a pale seta, setae becoming long, dense and broad towards apex.

Male genitalia with aedeagus straight, bilobed at apex and produced in middle in a long and narrow process, apex and sides strongly sclerotized; phallotreme subapical, with an orificial plate on each side; aedeagal apodemes very long and slender, nearly thrice as long as aedeagus; phallobase ring-shaped, its ventral apodeme longer than aedeagus and thicker than aedeagal apodemes; endophallus surpassing aedeagal apodemes anteriorly, with much dense rows of spine-like setae laterally and strongly denticulate centrally, papillate towards apex, with a small curved plate at apex. Female genitalia with long and weakly sclerotized ovipositor, with coxites comparatively more sclerotized and sparsely setose; bursa copulatrix well-developed, sclerotized towards apex; spiculum ventrale long and much slender, spathulate at apex. Spermatheca with cornu pointed, collum somewhat bent towards ramus.

Measurements

Length:
Male body: 6.1 to 6.6 mm;
rostrum: 0.9 to 1.0 mm.
Female Body: 7.3 to 7.7 mm;
rostrum: 1.0 to 1.1 mm.
Breadth:
Male body: 2.0 to 2.2 mm;
rostrum: 0.9 to 1.0 mm.
Female body: 3.0 to 3.2 mm;
rostrum: 1.0 to 1.1 mm.

Holotype, Male, INDIA: Assam, Sylhet, from *Euphorbia indica*, C. S. Sidhu. Material in Entomology Section, Department of Zoology,


BC
SD
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1.00mm
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6

Fig. 5. Female genitalia of *A. laesicollis* sp. nov.
Fig. 6. Female genitalia of *A. lunatus* Marshall.

Abbreviations

BC, Bursa copulatrix; C, Cornu; CO, Collum; CX, Coxite; OV, Ovipositor; R, Ramus; SD, Spermathecal duct; SV, Spiculum ventrale; V, Vagina; VIII, 8th sternum.

Punjab University, Chandigarh (11.x.1977).

Paratypes, 4 males and 4 females (same data as for holotype) (11.x.1977).

Remarks:

The present species can be easily made out from the only two other species known from India under this genus. Both the described species namely, *lunatus* Mshll. and *lefroyi* Mshll. carry distinct longitudinal bands of green and fuscous scales on the pronotum and elytra. This species is completely devoid of such distinct bands on the body.

A. lunatus Marshall

(Figs. 2, 4, 6)

Marshall, Ann. Mag. Nat. Hist. (11) *10*, p. 109 (1943).

The following information on the male and female external genitalia is being added.

Male genitalia with aedeagus straight, bilobed at apex, produced into a process in middle, its apical half strongly sclerotized; phallotereme subapical, with an orificial plate on each side; aedeagal apodemes more than twice the length of aedeagus; phallobase ring-shaped; phallobasic apodeme about as long as aedeagus, thicker than aedeagal apodemes; endophallus surpassing aedeagal apodemes anteriorly, with much dense rows of spine-like setae in basal half and strongly denticulate thereafter, papillate towards apex, having a small curved plate at apex. Female genitalia with ovipositor long and weakly sclerotized; coxites comparatively more sclerotized and sparsely setose; bursa copulatrix well-developed, with apical half sclerotized, provided with a membranous lobe at apex; spiculum ventrale long and slender. Spermatheca with cornu broadly pointed and curved, collum displaced and lying over ramus.

KEY TO THE INDIAN SPECIES OF GENUS *Aspidomycter* MARSHALL

1. Prothorax and elytra not marked with longitudinal bands of green and fuscous scales..*laesicollis* sp. nov.
   Prothorax and elytra marked with distinct longitudinal bands of green and fuscous scales......2
2. Each elytron with a green sublunate band at the top of the declivity..........*lunatus* Mshll.
   Each elytron with two transverse green bands—one about middle on intervals 4-6, the second posterior band not lunate and ceasing internally on interval 3 ....*lefroyi* Mshll.

ACKNOWLEDGEMENTS

We are grateful to U.S. Department of Agriculture and Indian Council of Agricultural Research for financing a five year project on Indian Curculionidae, We are also thankful to Mr. R. T. Thompson of British Museum (Natural History), London and Dr. P. K. Sensarma of F.R.I., Dehradun for allowing the comparison of collection and for generous loan of material. The laboratory facilities provided by the Chairman, Department of Zoology, Panjab University, Chandigarh are also gratefully acknowledged.

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A NEW SPECIES OF CLADOCERA OF GENUS *INDIALONA* PETKOVSKI, 1966 (FAMILY CHYDORIDAE) FROM INDIA[1]

Pramod Rane[2]

(*With four text-figures*)

Introduction

While examining the Cladocera collection from various localities of Madhya Pradesh, I came across several new species of Cladocera. The present paper describes a new species of the genus *Indialona.* The type specimens were deposited in the National Zoological Collection of the Zoological Survey of India, Calcutta-12.

Indialona jabalpurensis sp. nov.

Description: Body 1.2 time as long as high. Valve oval compressed laterally. Posterodorsal corner of valves slightly projecting. Posteroventral corner rounded, with 6 equally spaced denticles, placed at some distance from each other. Ventral margin of valve with a row of setae at its whole length. Valve with longitudinal lines which are only marked in the freshly preserved specimens. Rostrum blunt. Antennules ending less than their length before apex of the rostrum. Sensory setae longer than rostrum. Distal segment of the antennae coming out from the apex of rostrum. Postabdomen narrowing distally, with distinct preanal rounded corner. Anal denticles about 30, first are slightly recurved and placed closely associated with each other. Distal anal denticles are small and in groups. Claw with a basal spine which is more than half as long as the claw and with out setae on its cancave margin. Postabdomen has two spine like setae on the distal portion above the natatorial setae. Ocellus one third as long as eye, situated nearer to the eye than to the apex of the rostrum. Legs typical for this genus, outer ramus of endite of the first leg with curved hook like setae. Length 0.51 mm. Male unknown.

Type specimens: 1 ♀, Holotype, paratype two females. Two females are in 5% formalin and one is on slide. Cat. No. C 2890/2.

Type-locality: A hill-top tank near Madan mahal, 1 km. south-west of Premnager, Jabalpur, Madhya Pradesh, India, Coll. Pramod Rane, 8-3-1982.

Discussion

This species closely resembles *Indialona macronyx* (Daday 1898) but can be separated from it as follows: (i) Setae on the concave margin of the claw absent, but in *I. macronyx* these setae present (ii) Number of anal denticles about 30 and first 8 slightly recurved, closely placed nearer to each other but in *I. macronyx* they are 12-14, all are straight and of same length. (iii) Posteroventral corner of valve with 6 small equally spaced denticles, but in *I. micronyx* they are absent. (iv) Head portion with slight evagination of the valve above the eye region, but in *I. micronyx* that region is evenly round. (v) Sensory setae of antennules coming out of the rostrum but in *I. macronyx* these end before apex of rostrum.

Acknowledgements

I am grateful to Dr. K. Reddiah, Deputy Director-in-charge of this office for facilities to carry out this work. Thanks are also due to Professor C. H. Fernando, University of Waterloo, Canada for reprints of his valuable contributions on Cladocera and answering my inquiries about identification from time to time.

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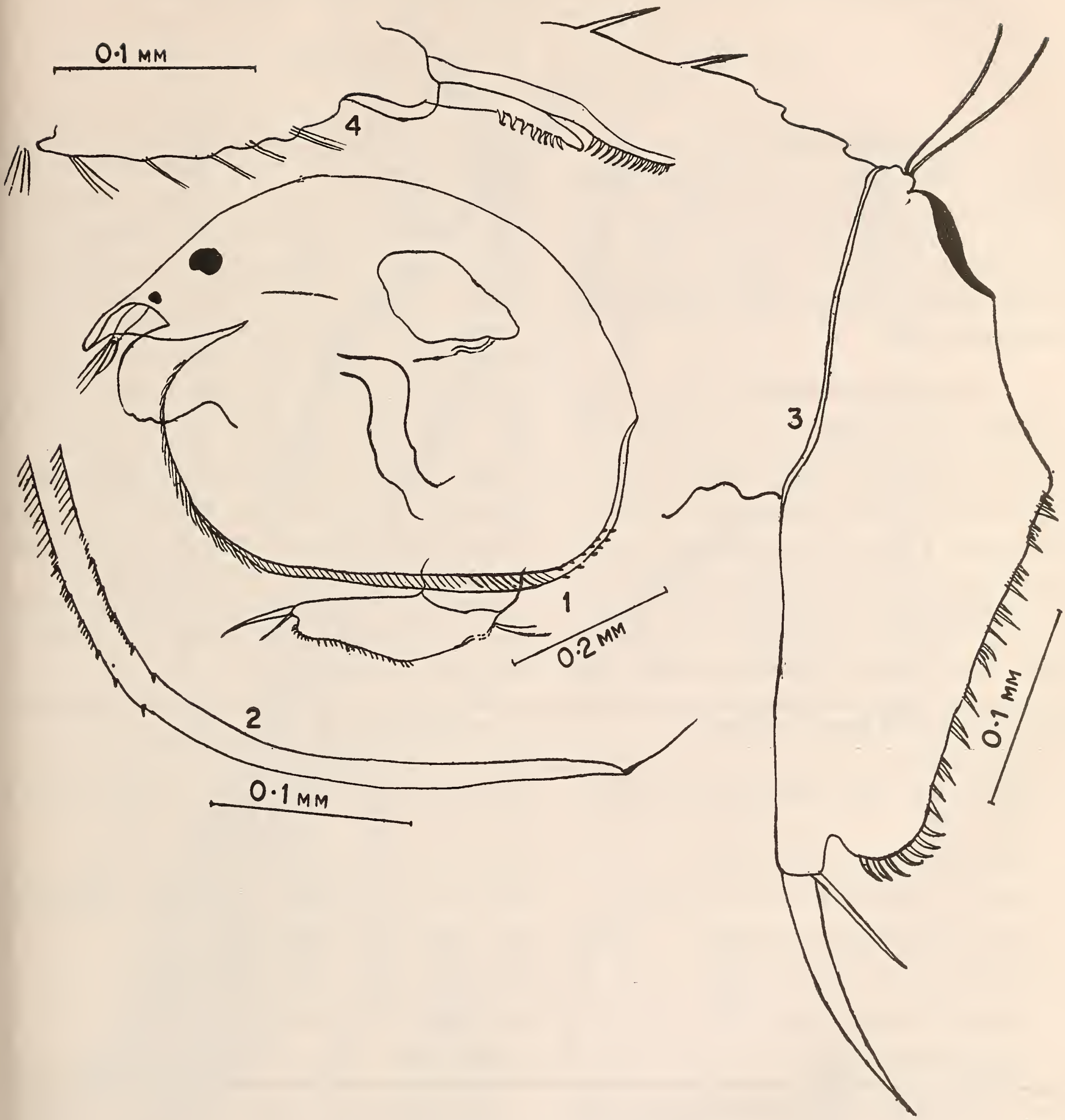
[1] Accepted April 1982.

[2] Zoological Survey of India, Central Regional Station, 1544/A, Napier Town, Jabalpur 482 002.



Figs. 1-4. *Indialona jabalpurensis* sp. nov.
1. Lateral view of female; 2. Posteroventral corner of valve, showing denticles; 3. Postabdomen, showing anal denticles; 4. Outer ramus of endite of first leg with curved hook like setae.

TRIPOGON NARAYANII — A NEW SPECIES OF POACEAE FROM KERALA, INDIA[1]

P. V. SREEKUMAR, V. J. NAIR AND N. C. NAIR[2]

(*With nine text-figures*)

Tripogon narayanii sp. nov.

Tripogon bromoides Roem. et Schult. affinis, sed ligulis membranaceis; spiculis viridoluteis ubi novis et cremeoalbis ubi exsiccatis; paleis angustioribus, ellipticis, glabratis, apicibus rotundis, carinis dimidiis superis ciliatis; antheris purpureis differt.

Tripogon narayanii sp. nov.

Densely tufted perennial herbs. Culms 10-20 cm high, nodes glabrous. Leaves 10-25 x 0.15-0.25 cm, linear, flat, densely villous on upper surfaces and sparsely villous below, midrib inconspicuous. Ligule a thin membrane. Sheaths villous, basal ones breaking up into fibres. Racemes 6-12 cm long, contracted. Rhachis smooth, glabrous. Spikelets 5-10 mm long, greenish-yellow when fresh and cream-white when dried, with 4-6 florets. Callus bearded. Lower glumes *c.* 3.5 x 1 mm, ovate-lanceolate, 1-nerved, shallowly notched on one side. Upper glumes *c.* 5.5 x 1 mm, lanceolate, 1-nerved, notched at apex with a very short mucra *c.* 0.5 mm. Lemmas *c.* 4 x 1.75 mm (excluding awns), coriaceous, 3-nerved and 3-awned; lobes on either side of median awn short, acute. Awns unequal, median awn *c.* 2.5 mm long, lateral ones *c.* 1 mm long, scabrid. Paleas *c.* 3 x 0.5 mm, elliptic, rounded at apex, 2-nerved, 2-keeled; keels ciliate along the upper halves, glabrous elsewhere. Lodicules 2, *c.* 0.25 x 0.15 mm, obovate, 3-lobed at apex. Stamens 3, anthers *c.* 1 mm long, narrow, purple coloured; filaments *c.* 2.5 mm long. Ovary *c.* 0.5 mm long, obovate. Styles 2, each *c.* 0.4 mm long, slender. Stigmas *c.* 0.6 mm long, feathery.

The present species is closely allied to *Tripogon bromoides* Roem. & Schult. with which it differs as given below:

Tripogon bromoides Roem. et Schult.	*Tripogon narayanii* sp. nov.
1. Ligule obscure	Lingule a thin membrane
2. Spikelets pale grey when fresh and dark grey when dried	Spikelets greenish yellow when fresh and creamy white when dried
3. Upper glumes prominently aristate	Upper glumes acute, not aristate
4. Paleas *c.* 1 mm broad, obovate, tip acute	Paleas narrow. *c.* 0.5 mm broad, elliptic, tip rounded
5. Keels of palea scabrid throughout	Keels ciliate in the upper half
6. Paleas hairy on the dorsal surface	Paleas glabrous on the dorsal surface
7. Lodicules 2-horned at apex	Lodicules 3-lobed at apex
8. Anthers cream coloured.	Anthers purple.

The holotype *P. V. Sreekumar* 68412 (CAL), Isotypes (K, MH) and paratype *P. V. Sreekumar* 68421 (MH) were collected from Eravikulam National Park, Idukki District, Kerala at an altitude of 2000 m on 28-8-1980.

The specific epithet is after Prof. N. Nara-

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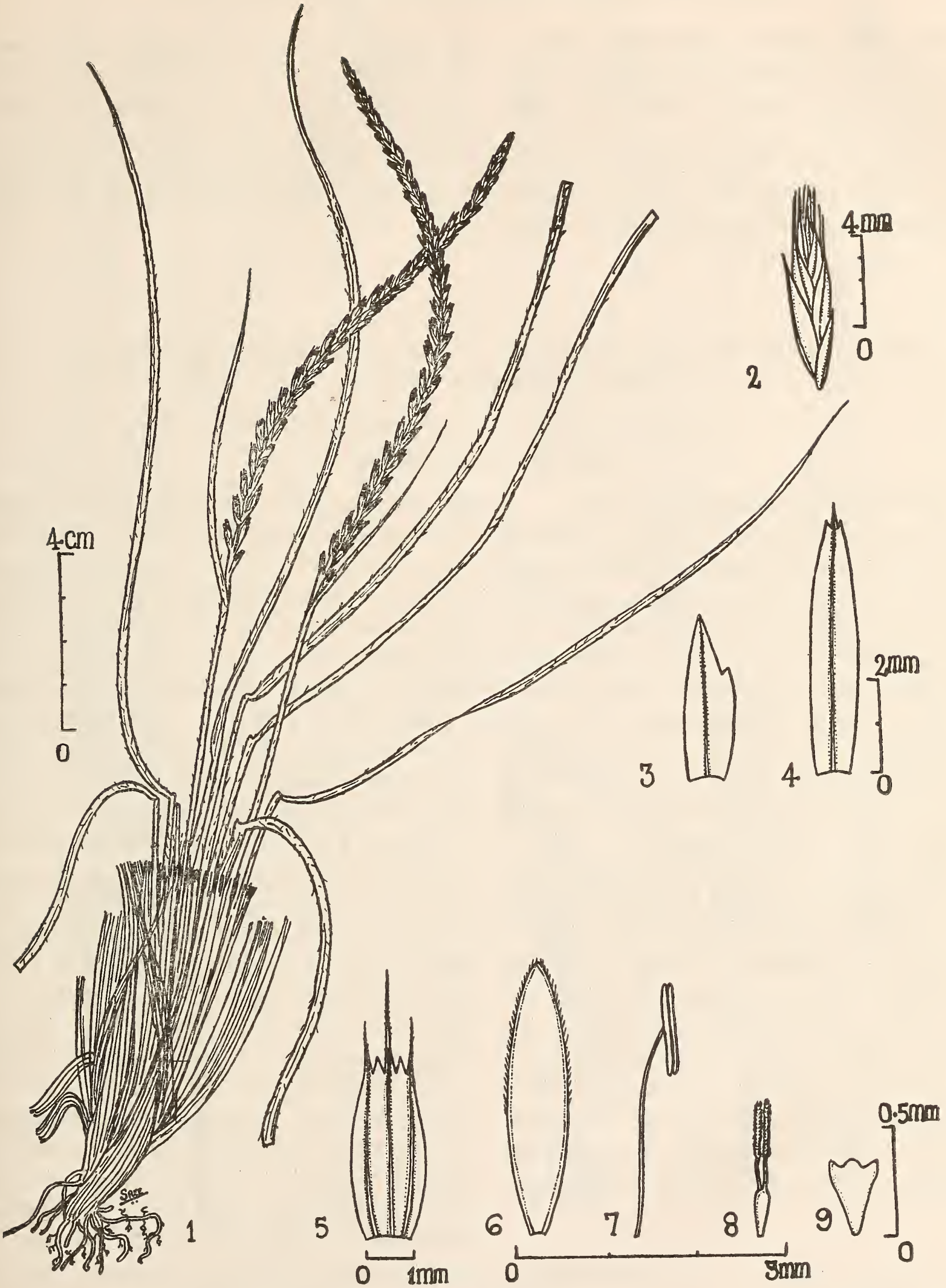
[1] Accepted February 1982.

[2] Botanical Survey of India, Coimbatore-641 003.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Figs. 1-9. *Tripogon narayanii* sp. nov.
1. Plant; 2. Spikelet; 3. Lower glume; 4. Upper glume; 5. Lemma; 6. Palea; 7. Stamen; 8. Pistil; 9. Lodicule.

yana Pillai, first author's teacher and Head of the Department of Botany, S. D. College, Alleppey, Kerala, who suggested Eravikulam area for intensive study.

Dr. Thomas A. Cope, The Herbarium, Royal Botanic Gardens, Kew, has given the following opinion (personal communication) about our specimen, "almost certainly a new species of *Tripogon.* Only two other Indian species share the same kind of lemma (3 awns, 2 lobes), *T. bromoides* and *T. filiformis.* It is clearly neither of these". We are thankful to him for his constant help and valuable suggestions.

CHRYSOPOGON TADULINGAMII: A NEW SPECIES OF POACEAE FROM KERALA, INDIA[1]

P. V. Sreekumar, V. J. Nair and N. C. Nair[2]

(*With fifteen text-figures*)

Chrysopogon tadulingamii sp. nov.

Chrysopogon lancearius (Hook. f.) Haines, lamina folii convoluta glauca ad basim rotundata, costa non prominenti, ligula tenui fimbriata membranacea, panicula parviore laxa, ramis paniculae breviores (usque 4 cm), spiculis perpaucis, pilis pedicelli brevioribus differt.

Chrysopogon tadulingamii sp. nov.

Perennials. Culms 30-100 cm tall, tufted, erect, slender; nodes glabrous. Leaves 5-15 x 0.1-0.2 cm, acicular or linear, rigid, convolute, glaucous, base rounded, glabrous or with a few long hairs near the collar. Sheaths 2-6 cm, equal to or shorter than the internodes, closely fitting, rounded, striate and glabrous. Ligule a thin fimbriate membrane. Panicles 5-15 cm long; branches 1-4 cm long, whorled in the lowest node, alternate above, with very few spikelets, capillary, slender, terete and glabrous; nodes bearded; spikelets in groups of three with a middle sessile spikelet and two lateral pedicelled ones. Sessile spikelet 5-6 mm long, oblong or oblanceolate, laterally compressed, grooved; callus 3-4 mm long, densely bearded with stiff chocolate-brown hairs 1-2 mm long; lower glume 5-5.5 x 0.75-1 mm, linear-lanceolate, coriaceous, brownish, setose towards apex; upper glume 5-6 x 1-1.5 mm, oblong, obtuse and awned at apex, awns 10-15 mm long, straight or slightly curved, scabrid; lower floret empty; lemma 3.5-4 x 0.75-1 mm, linear-oblong, acute, delicate, hyaline, margins long ciliate; upper floret bisexual; upper lemma 4-5 x 0.5-1 mm, linear or oblong ending in a very long, stout awn, 3-nerved, delicate and hyaline in the lower half, coriaceous and rigid in the upper, awn 50-60 mm long, geniculate, column 20-30 mm long, villous with short golden-yellow hairs, bristles scabrid; lodicules 2, each *c.* 0.4 x 0.3 mm, obovate, 2-lobed at apex; stamens 2-3, anthers 3-4 mm long, deep-yellow, filaments short; ovary 0.4-0.5 mm long, ovate, styles 0.75-1 mm long, slender, stigmas 1-1.5 mm long, pale-yellow, plumose. Pedicelled spikelets 8-10 mm long, purplish; pedicels 5-6 mm long, angular, dialated at the tip, covered with short golden-yellow hairs, callus hairs 0.5-1 mm long, brownish; lower glume 7-8 x 0.75-1 mm, lanceolate, acute or shortly acuminate, 3-nerved, purple, margins infolded, hyaline glabrous or

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[1] Accepted May 1982.

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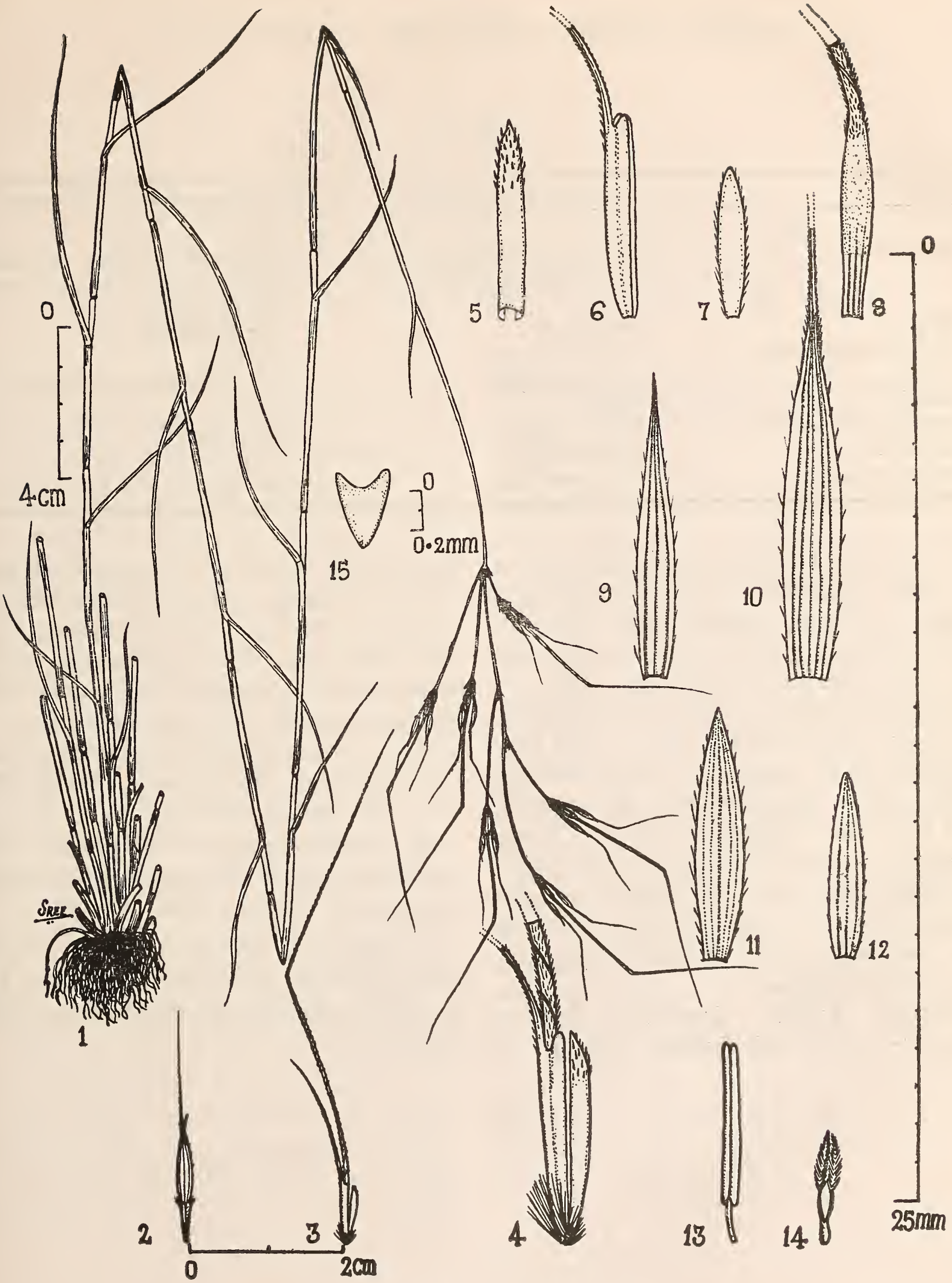
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Figs. 1-15. *Chrysopogon tadulingamii* sp. nov.
1. Plant; 2. Pedicelled spikelet; 3. Sessile spikelet; 4. Sessile spikelet-enlarged with a portion of awn; 5. Lower glume of sessile spikelet; 6. Upper glume; 7. Lower lemma; 8. Upper lemma with a portion of awn; 9. Lower glume of pedicelled spikelet; 10. Upper glume with a part of awn; 11. Lower lemma; 12. Upper lemma; 13. Stamen; 14. Pistil; 15. Lodicule.

TABLE 1

Characters	*Chrysopogon lancearius*	*Chrysopogon tadulingamii*
1. Leaf-blades	Flat, green, narrowed towards base and quite glabrous	Convolute, glaucous, rounded at base with a few long hairs near the collar
2. Midrib	Prominent	Not Prominent
3. Culms below panicles	Minutely hairy	Glabrous
4. Ligule	A row of hairs	A thin fimbriate membrane.
5. Panicle	Dense	Lax
6. Branches of panicles	5-10 cm long	up to 4 cm
7. Spikelets	Numerous	Very few
8. Hairs on pedicels	1-1.5 mm long	At the most 0.5 mm long

with a few shaggy hairs; upper glume 8-10 x 1-1.5 mm, lanceolate, acuminate ending in a straight or slightly curved awn, 7-nerved, purple, margins infolded, hyaline, with a few setose hairs especially towards apex, awns 10-15 mm long, straight or slightly curved, scabrid; lower floret empty; lemma 6-8 x 0.75-1 mm, oblong-lanceolate, faintly 3-5 nerved, delicate, hyaline, villous especially along the margins; upper floret male; lemma 4-5 x 0.5-0.75 mm, oblong, acute, faintly 2-3 nerved, delicate, hyaline, shortly ciliate along the margins; lodicules 2, each *c.* 0.4 x 0.3 mm, obovate, 2-lobed at apex; stamens 2-3, anthers 3-4 mm long, bright-yellow, filaments short.

Holotype: KERALA, Cannanore District, Periye, ± 50 m, 18th October 1981, *P. V. Sreekumar* 71758 (CAL). Isotypes in K, MH.

Rare, along dry rocky hill-slopes and open grasslands, usually in very dry habitats, along with other grasses such as *Themeda triandra* Forssk., *Dimeria bialata* C. E. C. Fischer, *Arundinella mesophylla* Nees etc.

This species is allied to *Chrysopogon lancearius* (Hook. f.) Haines, but markedly differs from it as shown in the table 1.

The specific epithet is in honour of C. Tadulingam one of the pioneers in agrostological studies in Southern India.

We thank Dr. Thomas A. Cope, The Herbarium—Grasses, Royal Botanic Gardens, Kew, for kindly examining our specimens and giving his opinion.

REVIEWS

1. WILD IS BEAUTIFUL. (Introduction to the magnificent, rich and varied Fauna and Wild Life of Nepal). Edited by Trilok Chandra Majupuria. pp. 507 (21 × 14 cm) with 59 colour, 45 black and white, 321 live drawings. Gwalior, M.P., 1981-1982. S. Devi. Price Rs. 200/- (post free for US $ 50.00).

The title is odd and puzzling but the subtitle explains it more clearly. Until 1950 Nepal was The Forbidden Land and the dream goal of naturalists and tiger-cum-rhino hunters. The latter are now practically extinct but the enormous wealth of animal life available in the area is mainly known from the collections made by members of the British Embassy in the last century. After the war and with changed circumstances others have had access and Japanese, German, American and other expeditions have made collections of various items adding to our taxonomic knowledge, but except for birds and perhaps the game animals our field knowledge is in almost all instances "nil".

There are chapters on Zoogeography, National Parks, Invertebrates, Insects, Aphids, Mosquitoes, Butterflies, Fishes, Amphibians, Reptiles, Birds, Mammals (and separately on several species) with others on Bird Migration, Pheasants, Spiny Babbler, Gharial, Yeti etc.

The book is dedicated to Robert L. Fleming Sr., while the chapter on Birds by R. L. Fleming Jr., is undoubtedly the most complete section. The other contributors and the Editor are mostly persons associated with the Tribhuvan University at Kathmandu, and other organisations like Ground Water Board (Physiography), National Parks, Deptt of Agriculture, Nepal Malaria Eradication Organisation etc., etc.

With the publishers, producers, composers, the printers of the colour plates and of the subject matter and photos all being different organisations as far apart as the Punjab and Thailand, it is difficult to determine who is to be blamed for the innumerable typographical errors which have found their way on to almost every page. Some are quite amusing: A pair of pelicans visiting Nepal presumably refers to two species, while it is not difficult to guess the identity of the Openbellied Stork. Some of the photographs and sketches are amateurish and also poorly reproduced.

Inspite of all this, the whole is indeed a magnificent effort at an "Introduction to Fauna and Wildlife of Nepal" (printed on the cover), particularly by a person whose interest was first aroused by seeing the Rhino diorama at the American Museum of Natural History. An attempt has been made by most of the authors to get together the relevant literature which is referred to in a Select Bibliography at the end, making the book a valuable reference for any work on the fauna of Nepal.

HUMAYUN ABDULALI

2. A CHECKLIST OF THE BIRDS OF PUNJAB AND CHANDIGARH. By H. S. Toor, A. K. Chakravarthy, M. S. Dhindsa, P. S. Sandhu and P. K. Ananda Rao. pp. 37 (21 x 14 cm). Ludhiana, 1982. Punjab Agricultural University. Price Rs. 4/-.

The publication of checklists of birds of different parts of the country is an indication of growing interest in Bird Watching. We have over 2100 different species and subspecies in India and a checklist of an average state would cover 400-600 species, thus lessening the search.

The frequency of local names raised the hope that the authors had been more successful than most workers until a more careful scrutiny revealed that the name *Jal Kukkri* applied to the Little Grebe, the Common Teal, The Whitebreasted Waterhen and the Moorhen, *Chaha* meant both Common Sandpiper and Fantail Snipe, and *neel sir* stood against the Mallard and Purple Coot! With the Collared Bush Chat as the Kalar Wala Pidda and the Spanish Sparrow as Speni Chiri it became evident that most of the names are manufactured. This may be a final necessity but the actually existing local names must first be exhausted before the improvisation starts.

Though a skeletal bibliography exists at the end, the total number mentioned adds up to 240 species and subspecies (against 416 in the checklist of the adjoining area of Delhi, Agra & Bharatpur). Together with the complete absence of all sandgrouse (3 loc. cit.), the omission of 11 out of 29 ducks and geese (in the same Checklist) 3 out of 4 Cranes, 6 of 11 Rails and Crakes, 11 of 15 Plovers, 8 of 17 Larks and many more including 32 out of 39 Warblers, makes it evident that the list is based on the personal observations of the authors as is said in the text (p. 3). But the term Checklist is then a misnomer and we can only hope the same or other authors will take up the matter more seriously and prepare a genuine one.

Though a Checklist can never be complete and final, it must bring together all that has been recorded. It must also be noted that Bird Watching by itself is not Ornithology, though it may lead to it.

HUMAYUN ABDULALI

3. THE FRESHWATER FISHES OF INDIA, PAKISTAN, BANGLADESH, BURMA AND SRI LANKA — A HANDBOOK. By K. C. Jayaram. pp. xxii+475 (24 x 16 cm) with 13 plates and 208 text-figures. Calcutta, 1981. Director, Zoological Survey of India. Price Rs. 100/-.

Every Indian zoologist, whether at undergraduate college level or as an accomplished ichthyologist, has had occasion to refer to the century-old monumental treatise by Francis Day, popularly known as "The Fishes of India", but whose full title reads: "The fishes of India, being a natural history of the fishes known to inhabit the seas and fresh waters of India, Burma and Ceylon." It is a tribute to his methodical, painstaking study that, even after the lapse of a century, his work of 1875-1878, comprising 1418 marine and freshwater species, is still invaluable for a taxonomic study of our fishes. And Day, to start with, was not even a professional zoologist; he was an Assistant Surgeon of the East India Company who came to India in 1852.

Taxonomy, especially of fishes, is notorious for its frequent — and to a neophyte, annoyingly perplexing — change in nomenclature, and the century since Day's work has been a proliferation of such changes. So it was but natural that ichthyologists would try their hand at revising updating the subject in India. The authority pre-eminently suited for such a revision was the late Dr. S. L. Hora who, in the early thirties of this century, was assigned this work. But, although he had to his credit well over 92 technical papers spanning a period of 33 years, his preoccupation with administration as Director of the Zoological Survey of India, and his untimely death in 1955, deprived him of the opportunity of a full-scale revision of Day's (1889) two volumes on Fishes in the "Fauna of British India" series. K. S. Misra then took up this work with his "An aid to the identification of the common commercial fishes of India and Pakistan", published from 1952 to 1962 and covering 402 species. For the revived "Fauna of India" series, he wrote three volumes, the last two of which were published posthumously in 1976. The need for a thoroughly revised book on Indian fishes continued to be felt. Dr. K. C. Jayaram's book now fills this important lacuna.

When ichthyologists first came to hear of Jayaram's new book, the general feeling was that it would be a re-hash of Francis Day's work. By browsing through the book, however, I could see that he has done his homework well, having taken great pains to bring out a well-researched survey of the taxonomic position of the 742 species covered by him.

Day had given a fairly detailed description of each and every species covered by him, together with half-tone illustrations for all of them (with very few exceptions). This necessitated a compilation running to 778 pages and 195 plates, bound as two voluminous tomes. By restricting his coverage to distribution lists and keys to species, Jayaram has successfully managed to have the book in a conveniently handy (and not heavy) single volume comprising 475 pages. This condensation may sometimes lead a novice to confusion in the identification of a species; one wishes the author would have at least given colour descriptions of *all* species, which he has done for quite many.

The author has included, in addition to the territories covered by Day (Pakistan and Bangladesh are encompassed in pre-independent India), fishes from Nepal and Bhutan as well.

His revision of nomenclature is thorough, and he has given previous generic positions wherever synonymic changes have taken place, thus clearing up a lot of confusion which would have otherwise prevailed. A few examples of new names for familiar old (but now discarded) fishes are: the genera *Pseudoxygaster, Dangila, Clupanodon, Chatoessus* and *Jerdonia* are now named *Securicula, Labiobarbus, Anodontostoma, Goniolosa* and *Enobarbichthys,* while *Laubuca dadiburjori, Gagata itchkeea, Colisa chuna* and *Muraenesox talabonoides* are now *Chela* (*Neochela*) *dadiburjori, Nangra itchkeea, Colisa sota* and *Congresox tala.* The author prefers to use the generic name *Harpadon* instead of the more familiar *Harpodon.*

A few technical mistakes have crept in. Thus, on page 13, the definition of "Scales from the back to lateral line" states: "generally the count is taken from the insertion of the first dorsal fin including the small scales, counting downward and backward following the natural scale row to but not including the lateral line scale." But Fig. 2A on page 8, illustrating this, shows the count as taken from two scales forward of this row, and the scale on the lateral line is included.

For Fig. 11 on page 18, the caption states "Outline drawing of *Tetraodon*" (puffer fish), but the illustration is of *Balistes* (trigger fish).

On page 52, for the family Notopteridae (feather backs or razor fishes), it is stated: "Dorsal profile not so convex as of ventral profile." Apart from faulty construction of the sentence, the reverse is true.

On page 56, the key no. 1 identifying *Salmo gairdnerii gairdnerii* states: "Body without spots below lateral line." But Fig. 34 of this fish shows a few such spots.

Again, although the author has taken care to revise the distribution of Indian fishes, on page 176 (footnote) he has wrongly retained Babu Rao & Yazdani's (1977) record of occurrence of *Botia dayi* (=*Botia rostrata*) from Mahableshwar. This has been subsequently found to be a wrong identification of *Botia striata* [see *Journ. Bombay nat. Hist. Soc.* 76 (3): 525-528].

A few errors/omissions in framing sentences have also crept in, which tend to confuse the reader. For instance, on page 22: Cranial air-bladder diverticula are lodged within bullae formed principally from to intercalare of each side (word missing between "from" and "to"). On page 52: The air-bladder diverticula is closely applied to the lateral aspects of two otic region (word "two" is wrong). On page 53: Eyes moderate, superior, in part of head. On page 60: Lips ..... reflected from one of the other. On page 61: Scales without any tile-like or sheath of scales (word "row" is missing between "tile-like" and "or"). On page 9': "..... a single row of degenerate along base of dorsal fin occasionally extending as far as scales tail". On page 144: Caudal fin to be almost of equal length (words "to be" should actually be "lobe"). On page 317: Mouth wide, protractile, one extending to front border of orbit or slightly beyond. On page 392: Skin covering modified into small or large spines or laminae in the form of a beak, having a cutting edge and covered with a layer of ivory-like substance (One line is missing between "laminae" and "in the").

The "Remarks" on *Garra*, comprising ten lines on the bottom of page 136, are repeated on top of page 139.

The technical perfection of the book is marred by very slipshod and careless editing. The reviewer could count well over a 105 spelling mistakes alone; an erratum sheet from the publisher is definitely needed. (A list of these mistakes is being sent to the author, as they are too numerous to be listed here.)

Apart from the numerous spelling mistakes, the text also suffers from the annoyingly frequent omission or misplacement of commas, which changes the meaning of many sentences.

In consideration of the handicap faced by a novice, the author has included in his book an elaborate glossary of words, as well as methods of various measurements. Had he given some illustrations about skull bones and/or included these in his glossary, the budding ichthyologist would have had his work still more easy. For example, words like ethmoid, hypural, parietal, pterosphenoid, post-temporal and zygapophyses are bewildering to the beginner.

The plates at the end of the book appear to have been added as an after-thought, or because money was available to print them. Many of them are redundant, as the same fishes are depicted as line drawings in the text, which latter are far superior in quality of print.

The first plate, depicting *Salmo levenensis, Carassius auratus* and *Cyprinus carpio communis*, are poor quality photographs of specimens with folded fins and drooping tails and do not give a correct idea of the fish's shape.

Plates II to XIII are, fortunately, half-tone illustrations, superior in quality to the photographs of Plate I. But one wishes that the author had depicted those fishes which had not been illustrated in the text. As many as 14 species are repeated both in line drawings in the text as well as in the plates. (See Table below)

Name of fish	Plate No.	Text fig. No.
Rasbora daniconius	II	43
Nandus nandus	II	183
Esomus danricus	III	41
Glossogobius giuris	V & X	193
Channa punctatus	V	172
Osteobrama vigorsii	V	55
Puntius sarana sarana	V & XI	53
Rhinomugil corsula	VI	191
Xenentodon cancila	VI	164
Accrossocheilus hexagonolepis	XI	59
Rohtee ogilbi	XI	54
Hilsa ilisha	XII	24
Tor tor	XIII	61
Catla catla	XIII	65
Channa marulius	XIII	171

The colour in the last two plates is highly distorted and not at all like the natural coloration of the live fishes.

If we neglect these lapses on the part of the author, we find that he has turned out an excellent treatise. His inclusion of brackish water fishes which visit fresh water is also welcome, inasmuch as 185 additional species are thus covered. A detailed bibliography at the end will help ichthyologists searching for original literature referred to in the text.

One wishes that Dr. Jayaram or some other fish taxonomist brings out a companion volume treating Indian marine fishes on the same lines.

The book is a "must" for every college and fisheries institution as well as to individual fish taxonomists, affordable at its modest price of Rs. 100/-.

B. F. CHHAPGAR

MISCELLANEOUS NOTES

1. ALBINISM IN THE HOUSE SHREW, *SUNCUS M. MURINUS* LINNAEUS

Albinism in the house shrew does not appear to have been recorded before. A beautiful albino female was collected alive in Jabalpur city, Madhya Pradesh on 16 October 1975 and kept alive in a wooden cage with glass top for about three days. The general colour ranged from pure white to dirty white. The naked parts and colour of iris was pinkish. The measurements in mm are: Head and body, 126; tail, 92; hind foot, 19.5; ear (from intertragal notch to the tip of the ear), 14.4. The specimen has been deposited in the collection of Central Regional Station, Zoological Survey of India, Jabalpur.

NATURAL HISTORY RESEARCH CENTRE,
BAGHDAD, BAB UL MUADHAM,
IRAQ,
June 9, 1982.

H. KHAJURIA

2. OCCURRENCE OF *PIPISTRELLUS PATERCULUS* THOMAS, 1915 (CHIROPTERA: VESPERTILIONIDAE) IN BIHAR: AN ADDITION TO THE INDIAN MAMMAL FAUNA

While examining the collection of bats from Bihar present in the National Zoological Collections (Zoological Survey of India, Calcutta), I came across two specimens of a pipistrelle (1♂, 1♀: Collector N. A. Baptista, 15 Aug. 1922, Z. S. I. Reg. No. 19899 and 16990 respectively) from Buhnar, Darbhanga Dist., Bihar, labelled as *Pipistrellus mimus* Wroughton. On detailed examination of the skulls, these were identified as *Pipistrellus paterculus* Thomas. The skull characters as mentioned by Tate (1942) for *paterculus;* 'profile sloping uniformly from brain-case to rostrum, top of rostrum broad, smooth and flat and basial pit absent', are present in these two specimens. Although externally the specimens are very much alike to *P. mimus*, the above mentioned skull characters clearly differentiate them from the latter.

This is, incidentally, the first record of *Pipistrellus paterculus* from India and extends its distribution much westwards from Mt. Poppa and Chindwin both in Burma to Bihar, India.

Measurements — External: Length: Head and body 39, 41; tail 29, 31; ear 11, 11 (taken by the collector); Forearm 26.6, 28.7; tibia 9.7, 11; foot including claw 6.2, 6.6 (taken from dry skins).

Skull: Total length 11.4, 11.7; zygomatic width 6.9, 7; length of brain-case 6.4, 6.6; length of rostrum 5, 5.1; maximum height of rostrum 3.6, 3.4; width of brain-case 6, 5.9; maxillary width (m^3–m^3) 5.2, 5.1; length of upper tooth row (c–m^3) 4.2, 4.4; length of lower tooth row (c–m_3) 4.5, –; length of mandible 8.3, –.

GANGETIC PLAINS REGIONAL STATION,
ZOOLOGICAL SURVEY OF INDIA,
RAJENDRA NAGAR, ROAD NO. 7,
PATNA 800016 (BIHAR),
April 28, 1982.

Y. P. SINHA

REFERENCE

Tate, G. H. H. (1942): Review of the vespertilionine bats, with special attention to genera and species of the Archibold Collections. *Bull Am. Mus. nat. Hist., 80*: 221-297.

3. FURTHER NOTES ON THE BIRTH AND GROWTH OF THE LEOPARD-CAT (*FELIS BENGALENSIS*) IN CAPTIVITY

Acharjyo and Mishra (1980) reported the birth of four litters to the female of a pair of Leopard-Cats (*Felis bengalensis*) at the Nandankanan Biological Park, Orissa upto December, 1978. The present note is intended to place on record the details of three more litters born to the female of the same pair of Leopard-Cats in the same Park.

The pair of Leopard-Cats were housed in an enclosure having the floor space of approximately 7 square metres, height 2.80 metres. There were two cave like retiring dens one above the other at a height of half a metre from the ground. Each of them was fed with 300 gms of goat meat and 50 gms of beef daily. One live chicken to each was given once a month in place of goat meat and beef.

Out of three litters born during the period from January, 1979 to August, 1980, two were recorded in March and one in June. The size of each of the three litters was always two and interestingly all the six kittens were females. The eyes of all these kittens were closed at birth and the eyes of four kittens under observation opened on 14th day (two kittens), 15th day (one kitten) and 16th day (one kitten). The canines of two kittens under observation erupted on 29th and 30th day respectively. The inter-parturition intervals recorded thrice (Dates of birth: 4.7.1978, 30.3.1979, 9.3.1980 and 30.6.1980) were 267 days, 344 days and 112 days respectively generally depending upon the period of survival of the kittens after birth. Unfortunately the female died in August, 1980. During the period from April, 1976 to August, 1980, she had given birth to seven litters.

The four kittens born on 30-3-1979 and 9-3-1980 weighed 113 to 120 g with a mean of 115.75 g and measured 24 to 26 cm from tip of nose to tip of the tail with a mean of 24.88 cm including tail lengths of 7 cm each at birth.

Growth: Weekly growth records of two (one female and one male) mother-reared kittens born in the Park on 4-7-1978 was maintained upto 37 weeks (about 8½ months) and the details are given in the Table.

Date	Age in weeks	Weight in Kg. Female	Weight in Kg. Male
4-7-1978	Birth weight	0.118	0.120
18-7-1978	2	0.232	0.243
8-8-1978	5	0.460	0.480
5-9-1878	9	0.845	0.910
3-10-1978	13	1.190	1.280
7-11-1978	18	1.760	1.780
19-12-1978	24	2.200	2.410
30-1-1979	30	2.880	2.900
20-3-1979	37	2.990	3.230

A study of this table reveals that the weight of the kittens were almost doubled at the age of two weeks and quadrupled at the age of five weeks. There is a little over ten fold increase of birth weight at the age of 13 weeks and appeared almost as large as the parents at the age of 37 weeks (8½ months). The table also reveals that the growth rate of the male kitten was comparatively faster than the female kitten.

Both kittens were able to come down from the upper cave like den on 4-8-1978 (32nd day) and started licking minced goat meat along with their mother.

The litter size of three births of this species at West Berlin Zoo was 1, 3 and 2 respectively, there were two females and four males and the births were recorded in April, July and October (Frese 1980). He has further given the estimated birth weight of four kittens as between 100 to 130 g.

The four births of this species were recorded as follows: February, 1; March, 1; May, 1; and July, 1 and the litter size was one to two with a mean of 1.75 kittens per litter (Acharjyo and Mishra 1980). They have further stated that there were four females and three males; at birth seven kittens weighed 93 to 120 g. (mean 113.14 g.) and measured 22 to 25 cm. (mean 24.14 cm.) tip to tip including tail lengths of 6.5 to 7 cm. and the inter-parturition intervals recorded thrice were 81,305 and 104 days respectively mostly depending on the period of survival of the young.

Prater (1971) states that the young of this species have been obtained in March and May and 3 to 4 kittens may be born in a litter. In India, this species mates in May and has 3 to 4 young per litter after a gestation period of 56 days (Asdell 1964).

Weekly growth record of a female kitten of this species maintained upto the age of 11 weeks and reported by Acharjyo and Mishra (1980) reveals the weight of 1.156 kg. at the age of 11 weeks. A single male kitten born in a litter doubled its birth weight in 11 days, quadrupled in 26 days and by 50th day there was an eight-fold increase in weight whereas the three male kittens born in another litter have doubled their birth weight in 25 days, quadrupled in about 44 days and increased eight fold in 60 days (Frese 1980).

VETERINARY ASSISTANT SURGEON,
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L. N. ACHARJYO

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BHUBANESWAR 751 007,
CH. G. MISHRA

October 4, 1982.

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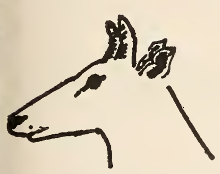
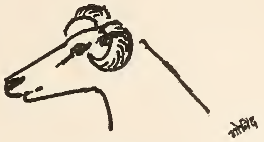
4. ABNORMAL HORNS IN THE NILGAI

(*With a text-figure*)

In April 1978 during my study of the wild dogs of Nagzira Wildlife Sanctuary (Bhandara District), I located a pack at the water hole at Umarzari, While walking towards them I saw a Nilgai-bull grazing in a plantation. The shape of its horn was unusual. It was curved down like a sheep's horn instead of the straight and vertical normal horn.



Normal.



Abnormal.

I inquired with local Shikaris and tribals and understood that such horns among the Nilgai, though rare, have been noted and such bulls are known as Mendha nilgai meaning sheep nilgai.

M. B. CHITAMPALLI

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5. GROOMING OF CHITAL BY LANGUR IN KANHA NATIONAL PARK, INDIA

A close association is known to exist between Hanuman langurs (*Presbytis entellus*) and chital deer (*Axis axis*) (Beck & Tuttle 1972, Nagel & Lohri 1973). Langurs drop large quantities of foliage, buds, flowers and fruits from trees while foraging which are subsequently utilized by chital. Close affinity may develop between a band of chital and a troop of langurs with the chital following a langur troop about the forest (Paul Newton, pers. comm.). In this note we record an observation of a langur grooming a chital in Kanha National Park in Madhya Pradesh in central India.

At 1320 hrs on 12 January 1982, we were travelling on elephant back through a mature Sal (*Shorea robusta* Roxb.) forest 5 km. S. of Kanha Village when we disturbed a small band of chital and associated troop of at least 10 langurs. One adult chital doe ran several metres, and stopped to watch us. When she stopped adjacent to an adult langur of unknown sex, the langur immediately walked toward the chital and began grooming its right rear flank while sitting on the ground behind the chital. We watched the grooming behaviour for at least 1 minute as the chital remained alert and motionless.

Langurs have been observed grooming domestic dogs (*Canis familiaris*) in Jodhpur (Sharma 1977) in an artificial association created by man. Toque macaques (*Macaca sinica*) in Sri Lanka have been observed grooming langurs but reciprocation has not been observed (W.P.J. Dittus, pers. comm.).

The natural association between chital and langurs appears to offer distinct advantages to chital since langurs knock food down from trees, and also elicit alarm calls when predators are observed. The relationship may be symbiotic commensalism because chital also give alarm calls when predators are detected and Roonwal and Mohnot (1977) suggest their sense of smell is keener than that of langurs.

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6. MATING BEHAVIOUR OF THE PLUMBEOUS DOLPHIN, *SOUSA PLUMBEA*, CUVIER, 1829

Free wild cetaceans are notoriously difficult to study for obvious reasons. Most of their activity and behavioural repertoire must take place beneath the water and out of sight of the human observer. Because there are so few written accounts of the behaviour of even the smaller dolphin species outside of the artificial conditions of aquaria and captivity, it seems worthwhile recording in detail observations made of a group of Plumbeous Dolphins in the Indus delta which corresponds closely with previous reported possible mating behaviour (see Pilleri *et al.* "Cetaceans of Southwest and Monsoon Asia", 1973-74).

The Plumbeous Dolphin (*Sousa plumbea*), is a neritic species preferring to feed close in shore and in tidal creeks and mangrove channels. It is a relatively large dolphin (adults measure 2.3 to 2.75 m. in body length and may weigh up to 200 kg.), with a prominently developed narrow rostrum or beak armed with about 36 sharp pointed and non-differentiated conical teeth in each jaw (Roberts, 1977). Such a physiognomy would enable it to prey upon quite large and swift fish species, but there is also evidence that small cuttle fish (*Sepia* spp.) and even prawns form a large part of their diet in Pakistan coastal waters.

Along the Mekran coast and particularly in Sonmeani lagoon and the Indus delta creeks, the Plumbeous Dolphin is quite common, being usually encountered in small groups of 5 or 6 animals and allowing smaller motor vessels to approach as close as 5 metres before diving deeply and taking evasive action by swimming underwater and at right angles to the passage of the boat.

The ususual behaviour recorded hereunder occurred between 12.00 and 14.30 hours on January 15th 1982 in clear sunny weather at a location known as Pitiani Creek, a wide channel some 60 miles southeast of Karachi and inside the labyrinth of the Indus mangrove channels. The observations were made from a hired fishing boat of approximately 16 feet beam, by Mr. Khan Mohammed Khan, Deputy Conservator of Forests and administrator of the Sind Wildlife Management Board, and by Miss Janet Knuckey, a New Zealand national who has previously made extensive studies of the Indus Dolphin (*Platanista indi*).

An unusually large school of Plumbeous Dolphins caught the attention of the party because individuals were leaping completely out of the water and producing loud splashes. Normally this species is relatively sluggish and does not leap bodily out of the water and keeps in small pods of 3 to 6 animals. In this instance an estimated 25 to 30 animals were observed in scattered groups over a radius of about 400 metres. They were in shallow water of about 3 metres depth and 50 to 100 metres from a sandy beach. Quite frequently silt from the bottom was stirred up by the cavorting dolphins which exhibited the following striking behaviour.

Broad side leaping: Adult animals would leap suddenly wholly out of the water, always on their sides or twisting while in mid-air and invariably trying to land back in the middle of the swimming pod of dolphins and always hitting the water on their right side. Only one individual at a time would do this, usually from amongst a group of 3 or 4 animals.

Vertical rising: This appeared to be the most significant behaviour pattern. Two animals would rise vertically out of the water, belly to belly and sometimes almost until three-quarters of their bodies were wholly out of the water. They would hold this position for 1 to 2 seconds only before sinking in the same vertical position back into the water. It is speculated by Dr. G. Pilleri who saw similar behaviour in the Persian Gulf (loc. cit.), that this was probably copulatory behaviour. Whenever this behaviour was deserved it appeared to involve only two animals with no evidence of any third dolphin in the vicinity. Moreover vertical rising always occurred well out in mid-channel where the water was presumably deepest, probably a necessary condition to achieve the acceleration required for breaching vertically (Khan Mohammed Khan, pers. comm.).

Tail slapping: One animal out of a group would raise its tail almost vertically out of the water until the dorsal fin was exposed and then slap it downwards onto the surface with a smack like a rifle shot. This did not cause any panic amongst the others in the group and was not a preliminary to diving and evasive action but seemed rather an expression of "high spirits".

Surface rolling: Two or three animals in one group would roll horizontally around one another and either on the surface or just beneath it.

Resting on the surface: A single animal would separate itself from its group, often approaching very close to the boat where it would hang motionless on the surface for several seconds, most of its dorsal surface being exposed. During this short interval it would expire audibly two or three times. Whenever a single individual was observed "resting on the surface", it appeared relatively close in shore and in the shallow waters. Generally before broadsiding, tail slapping or vertical rising was observed, a tight group of three animals would appear to synchronise their movements very closely, swimming close alongside each other and rising simultaneously to breathe.

Interpretations: These can only be speculative, but since these Dolphins rarely associate in groups of more than 6 to 12 animals, the aggregation of over 25 dolphins would appear to be associated with the oestrus state of certain females.

In a dolphin which normally never breaches out of the water, and if it does so it is with its body held in a vertical plane, the broad-side leaping within a close formation group could be an attempt by rival males to displace a consort and get close to an oestrus female. Tail slapping has been observed in *Delphinus* species as a warning signal, invariably followed by panic dispersal (Knuckey, pers. comm.) but in the case of these Plumbeous Dolphins no reaction was observed from associated animals and the display, if not one of "joie de vivre", was certainly not associated with panic or danger warnings. In fact until the group dispersed and swam purposefully away after almost 2½ hours of continuous observation, they appeared quite undisturbed by the proximity of the boat (which was of course drifting with the engine switched off).

Surface rolling certainly appears to be associated with courtship or mating behaviour whilst the surface resting could possibly be in associating with a second individual invisible beneath the water's surface or it might be the deliberate separation of one individual from a group while it rapidly inhales an extra supply of oxygen. If copulation actually took place at this time it would indicate a gestation period of approximately nine months, since females of this species are generally observed with small calves from late September and during October, and pregnant females have been autopsied in late August and early September.

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7. SOME OBSERVATIONS ON BREEDING OF THE CHINESE WHITEBREASTED WATERHEN *AMAURORNIS PHOENICURUS CHINENSIS* (BODDAERT)

The Chinese Whitebreasted Waterhen *Amaurornis phoenicurus chinensis* (Boddaert), locally known as jal kukkari, has become quite a common bird in the Punjab with the spread of rice cultivation during the last few years. Inspite of its common occurrence throughout the northern India, Sikkim, Bhutan duars, Assam, Nepal and West Pakistan, very little is known about its breeding habits (Ali and Ripley 1969). Even the incubation period had not been recorded so far.

We recorded some observations on a nest of this bird at Ludhiana (30°56'N, 75°52'E), Punjab and have been able to add some new information. A brief account of the observation follows:

Nest: The nest was located on a small mango (*Mangifera indica* Linnaeus) tree at about 1130 hr on 23 June 1981 near a stocking pond at the Fisheries Research Complex of the Punjab Agricultural University. It was built among branches of the tree 3.73 m high from the ground level. The material used to construct the nest was dry twigs, feathers, grass, dry leaves and pieces of polythene. Some thin iron wires and two comparatively thicker spokes of cycle wheel were entangled into the nest to strengthen it.

The nest was a cone-shaped structure having a cup at the top. The length (from lower to upper end) and diameter of the cone were 17 cm and 28 cm respectively. The cup was 8 cm deep and 14 cm in diameter. After completion of the clutch, the cup of the nest was lined with a layer of grass which decreased its depth by about 1 cm.

Eggs: The eggs are oval with light pink background and blotches of light brown, dark brown and light violet colour. The blotches are denser on the blunt ends of the eggs.

On 23 June, 1981, when the nest was first discovered there were four eggs in it. These were marked 1 to 4 with a lead pencil, measured with vernier callipers and weighed with a two-pan field balance true to 100 mg. Another egg was laid on 24 June and the clutch of six eggs was completed on 25 June. Earlier workers have reported the clutch size of this bird to be four to eight (Baker 1929, Whistler 1949, Ali and Ripley 1969).

The data on size and weight of the eggs and the dates of their laying and hatching have been shown in Table 1. Average size of 6 eggs was 38.75±0.92 × 28.70±0.34 mm. Earlier, Baker (1929) reported average size of 100 eggs of this bird as 40.5 × 29.7 mm. Average weight of the eggs was 17.47±0.55 g. The first four eggs could not be weighed afresh. This, however, does not seem to in-

TABLE 1

SIZE, WEIGHT AND THE DATES OF LAYING AND HATCHING OF EGGS

Egg No.	Length (mm)	Breadth (mm)	Weight (g)	Date of laying	Date of hatching
1	37.5	28.7	17.3*	?	12 July
2	37.9	29.0	17.5*	?	12 July
3	38.8	28.5	16.9*	?	12 July
4	39.9	29.2	18.5*	?	13 July
5	38.9	28.5	17.4	24 June	13 July
6	39.5	28.3	17.2	25 June	14 July
Av.	38.75	28.70	17.47	—	—
S.D.	0.92	0.34	0.55	—	—

S.D. = standard deviation.

* = not exactly fresh weight as these eggs were weighed on 23 June.

Incubation period on the basis of last egg = 19 days.

troduce error in the average egg weight because the birds probably started incubation after laying of the third egg (i.e., on the day the fourth egg was laid) as revealed by the hatching of first three chicks on single day (12 July). The weight of eggs starts decreasing only when the parents supply heat during incubation .

Incubation Period: Sixth egg of the clutch, which was laid on 25 June, hatched on 14 July. Therefore, the incubation period (on the basis of last egg of the clutch) was 19 days.

Newly Hatched Chick: The newly hatched chick of the Chinese Whitebreasted Waterhen is precocial and nidifugous. It is covered with silky black down feathers throughout the body excepting legs and bill. The bill is greyish black with sides of about 1/3rd anterior part of upper mandible and distal half of lower mandible whitish in colour. At the tip of the upper mandible is present a pure white egg tooth. Legs and feet are greyish black. The measurements of one chick at hatching were as follows: weight 11.7 g, culmen 10.5 mm, tarsus 19 mm and wing 23 mm.

Fate of the Chicks: It is already known that the chicks of this bird at hatching are very active (Ali and Ripley 1969). Therefore, the first hatched chicks probably leave the nest before hatching of all eggs of the clutch. According to Ali and Ripley (1969) this species usually constructs its nests either on the ground or "in the interior of a shrub or bamboo clump up to 2 to 3 metres from the ground". The present nest, however, was built among branches of a small mango tree at a height of 3.73 m. There was no vegetation at the base of this tree and the bare ground was quite hard. This unusual site of the nest and its more height from the ground proved fatal for the chicks. Three chicks which hatched on 12 July died by falling to the ground while attempting to leave the nest around noon of the same day. Two more chicks hatched and died similarly on 13 July. The sixth chick also met with the same fate on 14 July. The nesting success of the pair was, therefore, zero. Selection of the wrong nesting site seems to be the cause of reproductive failure of the pair.

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8. OCCURRENCE OF THE SOOTY TERN (*STERNA FUSCATA*) AT POINT CALIMERE, TAMIL NADU

After the publication of the earlier note (*JBNHS*, Vol. 78 (2): 377) I picked up another specimen of this species on the seashore at Point Calimere (10°18′N; 79°51′E), Thanjavur Dist., Tamil Nadu, on 17th June 1981. Only the wings (287 mm.) are preserved in the B.N.H.S. collection (Reg. No. 26083). This is the first record of its occurrence on the eastern side of Tamil Nadu, one storm-tossed (?) individual having been found at Tirunelveli (IND. HB. vol. 3: 62). It would appear that the species is occasionally found on the mainland, being swept inland or cast ashore.

In the meantime Mr. H. Abdulali (Per. comm.) again visited the Vengurla Rocks, West Coast, India on 10th May 1981 and saw several dessicated wings and remains of terns. They included one body and wings which are undoubtedly of this species and his first record (1942, *JBNHS*, 43 (3): 446-451) was no doubt correct. See his note below.

I thank Dr. R. Sugathan for providing facilities for the field work. This observation is part of the Society's Avifauna Project.

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V. C. AMBEDKAR

9. PIGEONS (*COLUMBA LIVIA*) NESTING ON THE GROUND — SOME MORE BIRD NOTES FROM THE VENGURLA ROCKS

Twelve species of terns have been recorded from the neighbourhood of Bombay and several of the marine forms were known to nest on the Vengurla Rocks, 4 to 5 miles off-shore about 200 miles south of Bombay and one of the few places where they are known to do so.

As far back as February 1875, Hume (*Stray Feathers* 4: 420) visited Burnt Island the largest of the group and found innumerable addled and broken eggs with dessicated corpses of young and old birds, which he confidently named as the Brown-winged Tern *Sterna anaetheta*. In addition he found a few very much larger eggs which were too decayed for preservation but which had "the characteristic markings of one of the larger Laridae" and which may well have been of *Sterna bergii*.

In February 1938 and March 1941, I visited the island again (*JBNHS* 41: 661-664, and 43: 446-451) and though no terns were seen on the island we found evidence similar to that obtained by Hume for the nesting of *Sterna anaetheta, fuscata, bergii, repressa* and *dougalli*. In view of the element of uncertainty attached to the identification of *S. dougalli* and the possibility of having over-looked some of the other oceanic species occasionally washed into Bombay during the monsoon, I had always wanted to make a visit during, or as close as possible to, their breeding period, presumably during the monsoon i.e. June to September.

Early this year I was able to get the assistance of Vice-Admiral M. P. Awati, Flag Officer Commander-in-Chief, Western Naval Headquarters, Bombay, who offered to have us dropped on the island by a naval frigate *en route* to Goa and to pick us up on its return a day or so later.

Accompanied by Rishad Naoroji, a keen photographer of birds, we boarded the I.N.S. "Himgiri" on the night of Friday 8th May 1981. The ship sailed on the following morning and during the coming night anchored about 1 mile south-east of Burnt Island.

When forty years younger, I had discovered that the rocks were "the hardest in the world to sleep upon" and this did not make me very anxious to be marooned thereon for twentyfour hours or more with no terns to look at. It was therefore arranged that we land early in the morning and decide in half an hour if we would like to be taken off at 11 a.m. or stay till the morrow. A helicopter *recce* put out at 6 a.m. came back to report some "sparrow-like" birds. We took off in a motor-propelled whaler at about 6-30 a.m. with the paraphernalia necessary to stay overnight. As we approached the rocks a large flight of birds in the distance which appeared to have taken off the island raised hopes. A little nearer, we saw small flocks of pigeons (*Columba livia*) come off the lighthouse rock, and it was evident that the others could only be the same, though as many as a hundred were seen together at one time.

On the first trip we had seen a small flock of 10 to 15 pigeons, including an albino, and noted that one collected had fed on grass seeds. Hume had also seen them in 1875. The second time he noted a few flying out of the cave. Their numbers had now multipled enormously. There can be no doubt that these are feral and must have originated from those on the lighthouse island half a mile away. They have probably resorted to nesting on the flat ground after the standard ledge sites inside the cave and elsewhere were exhausted. There is no evidence of their going to the mainland to feed, but the large flight first seen may suggest some form of concerted movement. I would estimate about 200 pigeons on the island.

Landing had to be made by jumping on to tide-washed rocks, and our luggage, including the camera, was left behind. The island was more broken up than I remembered and we clambered through the coarse grass and other low vegetation which covered every inch of the island which was not bare rock. The dried-up remains of birds picked up in the opener areas included mummified chicks and wings of pigeons and terns but the latter appeared to be fewer than before.

Out of the dense grass and other vegetation numbers of pigeons rose with a fluster in the manner of the Painted Partridge when beaten out near Bombay (though of course never so numerous !). A closer examination revealed that the birds were rising off their nests mostly with 2 eggs or young. Some 15 nests were examined. As I did not remember seeing or reading of pigeons nesting on flat ground in the shelter of small overhanging stones or tussocks of grass in the manner of game birds, the apparent sparsity of the remains of terns and the abundance of the pigeons, prompted the suggestion that the latter had driven off the terns and appropriated the island to themselves. I put this to Derek Goodwin of the British Museum (N. H.) at Tring and though he did not think this likely he suggested that I put my notes on record, for they were unusual. He also referred me to Moreau in *Ibis* 1944: 36 where he noted the surprising predilection of the dove *Streptopelia semitor-*

quata Ruppel for islets in the Mafia group all down the east African coast. Here Piggot found many of them nesting (with eggs) in bushes on the coral islets, "where they come flighting in to roost from the mainland every evening."

The cave where we had seen numbers of the Edible-nest Swiftlet was examined from the fallen-in-skylight. Some of the Swiftlets were seen (9.30 a.m.) flying about near the entrance both over the sea and the island. On our earlier visits we had only seen them when they left at daylight and returned in the evening. No nests were visible from the skylight and it was difficult to imagine how we had reached the mouth of the cave at sea-level without any ropes.

Four Turnstones were seen on the tide-flooded floor of the cave entrance. This was rather late in the season.

Except for the remnants referred to above, there was no trace of the terns until at about 10 a.m. Rishad drew attention to some 50 birds circling up in the air east of the island over the water half-a-mile away. They were largish birds with the upperparts showing brown and the underparts pure white when they turned in flight. The bill and feet were dark. They were undoubtedly *Sterna anaetheta.* After some watching they appeared to be of 2 distinct sizes, the larger birds showing black and not brown above. These were *fuscata* a fact confirmed by the measurement of the dry wings picked up on the island. This removes the doubt regarding this species expressed after examination of the material collected on the second trip. There were many more *anaetheta* than *fuscata.* They flew in circles fairly high over the water making no attempt at fishing. They would occasionally scatter and reassemble on the other side of the island. Single birds or pairs often separated and flew in a line towards the island, but did not reach it.

Three large terns with orange bills (*S. bergii*) flew across, calling loudly.

On the west of the island about half-a-mile away large numbers of small terns were scattered over the water, many moving together but all more or less staying in the same area.

The mummified chicks were identified by Dr. Jon Fieldsa, Zoological Museum, University of Copenhagen, Denmark, as of the Little Tern (*Sterna albifrons* subsp.) and this is the first record of this species nesting on this island. The subspecies could not be determined but the nearest breeding records from near Bombay are of *S. a. sinensis* the White—shafted Ternlet.

We are indebted to Admiral Awati for arranging the trip and to Captain Singh for the courtesy and co-operation extended to us during the voyage. We hope it will be possible to visit the island again at a more opportune time and get more information about the birds which nest there and also determine if the increase in the number of feral pigeons has in any way affected the breeding of the maritime species.

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HUMAYUN ABDULALI

10. GOLDEN ORIOLE (*ORIOLUS ORIOLUS*) NEST IN BOMBAY

I was surprised when I learnt that there was no authentic record of the Golden Oriole (*Oriolus oriolus*) nesting in the Bombay area, the nearest record of nests, as Mr. Humayun Abdulali informed me being from Pune in the Deccan and from Baroda in Gujarat state.

I had observed the oriole breeding during 1979-80 around Kandivli, a suburb in North Bombay. Also, I had found a pair making a nest sometime in May-80 on a jambool tree near the MLA hostel at Churchgate. Unfortunately this pair did not breed there and the nest was subsequently destroyed. However, this year (1981), on 8th May, a nest of the Golden Oriole was found on the grounds of a cattle farm at Kandivli.

The nest was about thirty five feet high on an outhanging branch of a huge Rain tree (*Pithecolobium saman*). According to observations that could be made from below the bird was probably incubating. It would occasionally be away from its nest for as long as 15-20 minutes after which one of the birds would come and settle in the nest—incubate? This was surprising, because hardly 25 feet from the Oriole's nest was a nest of the Common House Crow (*Corvus splendens*), where the bird was incubating. Also not very far from the Oriole's nest, a Black Drongo (*Dicrurus adsimilis*) was seen making a nest which it abandoned when the nest was more than halfway through.

This nest of the Golden Oriole being a new record for Bombay and its surroundings, I contacted Mr. Humayun Abdulali, who came down and saw it on the 14th May. On 29th May, the female Oriole was seen bringing food to its nest, to its nestlings. According to a friend, Joslin, the nestlings flew away in the second week of June.

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J. RODRIQUES

45/46, "MADHURIMA",
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11. NOCTURNAL HABITS OF BLACK DRONGO (*DICRURUS ADSIMILIS*)

On many occasions I have observed drongos hawking insects at street lamps at night. Several birds would perch on the electric wire and make aerial sallies on insects attracted by the light, especially after first rains when swarms of insects come out of the ground and fly around street lamps. Once I saw a drongo making a dash at a Spotted Owlet (*Athene brama*) which was perching on a wire. What is interesting is that the drongos appeared to be quite active around the light even though it was pitch dark everywhere.

No mention has been made about this behaviour in available literature.

NITIN JAMDAR

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12. HABITS OF THE BANK MYNA, *ACRIDOTHERES GINGINIANUS*

In the HANDBOOK (1972, Vol. 5:1981-2) there is a lively description of the habits of the Bank Myna, *Acridotheres ginginianus*, which in addition to its presence in restless small flocks near refuge dumps, railway stations, near food stalls and some bazaars (Old Delhi), is traditionally found in fields following the ploughing cattle or perched familiarly on cattle and buffalo's backs and heads looking for ticks or insects disturbed by their feet. My wife and I with an American Embassy Officer, Peter Kaestner, had been commenting on the species' characteristic presence in cultivated land near cattle on Janaury 12, 1982 near the Sultanpur Jheels in Haryana while bird watching.

On January 13, the following day, the two of us took the morning Delhi-Bombay flight from Delhi airport. On our way out to the aircraft, wandering over the vast artificial desert of tarmac with parked and moving planes, there were no birds visible except for an occasional moving kite taking advantage of a thermal updraft. However, we soon spotted a new adaptation of the cattle-riding habit. Here and there in the scattering of vehicular traffic, there were food catering vans, coming or going to the parked planes. Riding confidently on the roof, the front bonnet, or the rear ledge near the open sliding rear door of the food carrier were groups and individual busy Bank Mynas, the only bird species seen, quite at home and seemingly well adapted to their novel conveyance. They clustered only on the catering vans, not on the buses or cars, or fuel tankers. The Bank Myna appears to have adapted thus to a new urbanized niche, as I have not noticed them before in this otherwise sterile environment.

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January 15, 1982.

S. DILLON RIPLEY

13. SOME OBSERVATIONS ON THE INTELLIGENCE OF CROWS

It is interesting to watch the behaviour of birds and specially of crows. Wherever water pots are hung on the branches of trees for birds, it is fascinating to watch the types of birds namely pigeons, sparrows, bulbuls, babblers, parakeets, doves, mynas, sunbirds, crows and other smaller birds perch on the pot to drink. Once the birds get used to certain water pots they visit them regularly and some time baffled when the water level is not replenished or the pot is empty. Invariably, it has been seen that crows consume the maximum share from the pot. It is interesting and surprising to observe a crow carrying in its beak a dried piece of bread (Chapati) and placing it inside the water pot for a couple of minutes, then it picks up and settles down on a higher branch to consume it. Thus it is evident that the object of placing the dried piece of bread is to soften it for easy consumption.

Another instance observed was that when a crow is about to build its nest, it picks up lots of small thin sticks from all over like any other bird. When it gets hold of a small lump of coconut fibre, it carries the same and places it inside the water pot for a few minutes. The thoroughly soaked bit of fibre is picked up and the crow settles down on the ground. By pressing the lump of fibre on the ground with one claw, the crow peels off small strips with its beak and thus manages to use the entire lot for its nest. Such intelligence is probably noticeable in the case of crows only.

K. D. MUTHANA

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14. NEST BUILDING ERROR BY A FEMALE PURPLERUMPED SUNBIRD

In July this year I was watching a Purplerumped Sunbird building her nest in a Bougainvilia bush in my garden. The usual excited twittering which accompanies this activity could be heard throughout the day for about a week.

On closer inspection of the completed nest I was surprised to find that she had made a strange error during it's construction. *The nest had no opening at all.* It was closed all round like a deflated balloon. There was no attempt at a projecting porch either. The pendant nature was basically like a normal nest, but it was not fully expanded like a correctly designed one.

After several days of excited twittering and repeatedly settling on the nest and hopping all around it, the pair unhappily left it alone. The female sunbird appeared agitated but was unable to take any corrective steps to create a hole, after the completion of the nest. This was not surprising as the entrance hole is formed during the early stage of building the nest.

I find that in a fairly large number of nests the entrance hole is placed facing the bush. I presume that the birds prefer to alight on the nest after having checked out its safety by hopping around in the bush if danger appears to be at hand. In this case there were several other trees and bushes close to the nest site. This may have confused her about its placement? The rather thin appearance of the nest is explainable, as I have noticed that the female after nearly completing the nest enters it, and by ruffling out her wings repeatedly expands it from within. This increases the space inside and probably makes the nest more comfortable for her. Since there was no way of entering this nest she could not get inside for finishing touches. However, I was unable to find out what had gone wrong during building of this nest.

Could this have been a young immature female perhaps indulging in nest building for the first time? Is it possible that she could not decide in which direction to place the hole and thus did not make one at all?

ERACH K. BHARUCHA

23/5 Bund Garden Road,
Pune-411 001,
October 14, 1981.

15. COMMUNITY BATHING BY SUNBIRDS AND WHITE-EYES IN SUMMER

At the peak of the summer when Pune is incredibly hot and dry, I have observed a rather unusual phenomenon. At sun-up on these very hot mornings there is always some moisture on the wide banana leaves. A large number of Purple Sunbirds, Purple rumped sunbirds and White-eyes collect on these leaves for a community bath. I have seen several birds, as many as twenty at a time, aggregated on the four banana trees in my garden. They have a bath on the wet drops, and sometimes also drink the drop. I have seen them fluttering their wings and sliding down the sloping central rib. They also turn on their side to wet their wings more effectively.

The birds often squabble over the leaves which have the most moisture. As the sun rises further the leaves dry up and the birds move off to come back the next morning.

This summer I watched this for about three weeks, by which time the monsoons came and put an end to this daily morning activity.

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ERACH K. BHARUCHA

16. RECIPROCAL PREDATION BETWEEN A WEAVER BIRDS AND A LIZARD SPECIES

While studying the ecology of weaver birds in the Punjab, we have come across an interesting interaction between a weaver bird and a lizard species. We observed adult Baya Weavers *Ploceus philippinus* (Linnaeus) hunting small young of the Common Garden Lizard *Calotes versicolor* Daudin and feeding them to their nestlings on 24 August 1979 at Village Bias Pind, District Jullundur. The parts of young *Calotes* lizards were also recovered from the gut of 10.9% (6 out of 55) Baya nestlings killed for studying their food from the same area during 1979. This clearly established that these lizards were common constituents of the nestling diet of Baya in the study area. On the contrary, the adult lizards of the same species were recorded feeding on eggs of the Baya Weaver birds. Therefore, *Ploceus philippinus* and *Calotes versicolor* were predating upon the young stages of each other.

There are no earlier records of the Baya Weaver feeding on lizards in any part of India. However, *Calotes versicolor* is already a known predator of eggs and young of birds (Smith 1934). Ali and Ambedkar (1957) also recorded a *Calotes* lizard feeding on eggs of the Baya. In the study area, *Calotes* lizards were observed predating also upon eggs of the Blackthroated Weaver *Ploceus benghalensis* (Linnaeus) and the Streaked Weaver *P. manyar* (Horsfield) but these two weaver species did not predate upon lizards.

According to Professor T.R.E. Southwood (Pers. Comm.) there may be several other similar instances, particularly where the young stages of the predators are smaller. There has been no particular term applied to such observations as yet and, therefore, the term 'reciprocal predation' is proposed hereby. Reciprocal predation in general can be defined as predation by a prey species on the young stages of its predator species.

ACKNOWLEDGEMENTS

We are grateful to Dr. T. R. E. Southwood, Linacre Professor, Department of Zoology, University of Oxford for replying to our enquiry and giving useful comments and suggestions. The first author is thankful to the Forest Research Institute, Dehra Dun (U.P.) for financing his research on weaver birds with a Wildlife Research Fellowship.

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17. SIGHT RECORD OF *SERINUS PUSILLUS* AT MANANG, CENTRAL NEPAL

On 17 November 1981 we observed an adult Red-fronted Serin (*Serinus pusillus*) at about 3960 m near Manang, central Nepal (approx. 28°50′N, 83°55′E). The bird was first seen at 1540 hours at a distance of about 2.4 m, perched in a small thorn bush (*Carangana* sp.) on an arid scrub-covered hill side. It was noted as a small, heavily streaked finch, with a dark face and red forehead but colours were difficult to determine as we were looking into the sun. It was flushed after about half a minute and flew off down the slope accompanied by a second bird. It was relocated after a minute about 10 m away and was observed for a further minute perched in a thorn bush and on the ground. The red 'guardsman's cap' top to the head and dark face were very conspicuous; the body was a pale yellowish background colour, heavily streaked dark brown; the pale orange-yellow rump was obvious in flight. The second bird was only observed briefly and appeared to be similar to the first.

The Red-fronted Serin ranges across the mountains of Asia Minor as far east as the north-western Himalayas, Ladak and Kashmir (Paynter 1968, Hüe and Etchécopar 1970). Flemming *et al.* (1979) record it as "fairly common" in North Nepal occurring "as far east as the Kali Gandaki", which they regard as a biogeographical division between Eastern and Western species. Our record appears to be the most easterly of the species in Nepal, being to the east of the Kali Gandaki Valley and separated from it by a spur of mountains running north from Annapurna Himalaya.

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VICKY J. HAMILTON

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18. OCCURRENCE OF *EMBERIZA CIA* NEAR PUNE

The occurrence of Rock Bunting (*Emberiza cia*) has been recorded on four instances since 1977 near Pune. A single bird was observed on all occasions. A photographic evidence to confirm though not of good quality, was obtained on one of the occasions. The details of occurrence and habitat are as below.

Occurrence:

Date	*Place*	*Location from Pune*	*Altitude*
3rd June, 1977	Katraj	8 kms South	Between
22nd July, 1980	Khambataki	60 kms South	650-700
5th March, 1981	Bopadeo	8 kms South	metres.
18th June, 1981	Katraj	8 kms South	

Habitat:

All the above places happen to be near Ghat roads. The northern slopes of these Ghats (where all four birds were seen in the various instances) are gradually sloping and are at lower altitudes as compared to their respective southerly slopes. The birds were seen on stony barren slopes at the base of the hills. The habitat in general was stony scrub jungle.

Field Characteristics:

The typical black bands on the forehead, crown and cheeks together with bluish-grey chest confirmed with the field characteristics of a Rock Bunting. The bird seen in the month of July showed rich chestnut-brown breeding plumage. The sex identification, however, could not be done in the field.

Behaviour:

The solitary birds were seen eating grass seeds and calling 'chee-up chee-up' during their short dipping flights. They were often seen on almost vertical walls of loose red soil (Red bowl) on rocky clefts.

Typical birds seen in the Habitat:

Crested Bunting (common resident), Grey-necked Bunting (winter visitor, found to stay back till late June), finch larks, Whitebellied Minivet, Painted Sandgrouse.

123 KASBA PETH,
PUNE-411 011,
November 6, 1981.

SHRIKANT INGALHALIKAR

19. UNUSUAL BIRD RECORDS FROM THE BOMBAY AREA

I spent from 10th to 14th December 1981 in northern Bombay and subsequently submitted a list of the birds seen, to Mr. H. Abdulali. He kindly pointed out that the following three records were somewhat unusual.

Anser indicus (Latham) Barheaded Goose

Three flew low over Powai Lake at 07.15 on 14th December, circled round the lake, but did not settle.

Buteo rufinus (Cretzschmar) Longlegged Buzzard

Single birds seen in flight over Borivli National Park on 13th December and over Powai on 14th December were identified as belonging to this species. The former had a pale rufous tail and was probably an adult; the latter was a juvenile with a pale tail with dark terminal bars. Although Sálim Ali and Ripley (1978) are dubious about the specific identification of Buzzards in the field, it seems worth recording these sightings in view of the increasing number of such records in the Bombay area.

Chlidonias hybrida (Pallas) Whiskered Tern

Two birds were seen regularly during my stay at Powai Lake. This species may well be a regular winter visitor, though records for December appear to be lacking.

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20. GROWTH RATES IN SUB-ADULT GHARIAL *GAVIALIS GANGETICUS* (GMELIN) (REPTILIA, CROCODILIA)

(*With a text-figure*)

Bustard and Singh (1980) provided an outline of growth rates in young gharial from hatching to an age of 4.5 years. The only published data on growth of larger gharial are limited data provided on a male gharial reared at Nandankanan Biological Park, Orissa (Biswas, Acharjyo & Mohapatra 1978).

As a part of the State Crocodile Project, a gharial breeding pool was constructed at Nandankanan Biological Park, Orissa, in 1975, and three existing sub-adult gharial were introduced to this pool on 13 Ferbruary 1976. This group comprised of one male and two females. All three were from Mahanadi river, Orissa. The male was brought to the Park on 22 March 1963 at a length of 1.35 m. Its age at capture was subsequently estimated as 33 months (Singh 1978). The females were brought in November 1964 and November 1965 at lengths of 0.9 and 1.20 m and at estimated ages of 17 and 29 months respectively. From 1975 they were measured annually. Biswas *et al.* (1978) state that this male measured 2.5 m in January 1973 and 2.56 m in January

TABLE 1
GROWTH OF ONE MALE AND TWO FEMALE SUB-ADULT/ADULT GHARIAL (Length in m)

Year	Date of measurement	Length		
		Male	Female 1	Female 2
1975	31 January	2.56	2.48	2.45
1976	13 February	2.70	2.65	2.50
1977	11 December	2.72	2.96	2.73
1978	20 December	2.79	3.09	2.80
1979	15 December	2.84	3.12	2.82
1980	23 July	2.90*	3.17**	2.88
1981	23 March	—	3.25	3.00
Mean annual increment		6.8cm	12.8cm	9.1cm

* Killed in a conflict with an introduced male (Bustard and Maharana, in press, b) and measured following its death on 8 February 1980.
** Measured on 20 April 1980.

1974. The data, therefore, cover six years growth and are presented in Table 1 and Figure 1.

These data are of great interest in that the gharial were maintained in a large pool simulating the natural environment (Bustard and Maharana, in press, a) and Nandankanan is located within the natural distributional range of the gharial (Mahanadi river is only 5 km from the park). Hence growth rates following their introduction into the breeding pool are considered to closely approximate those occurring in nature.

It is interesting to compare the growth rates between the sexes (Fig. 1). At the start the male was slightly larger than either female. However, both females grew rapidly between

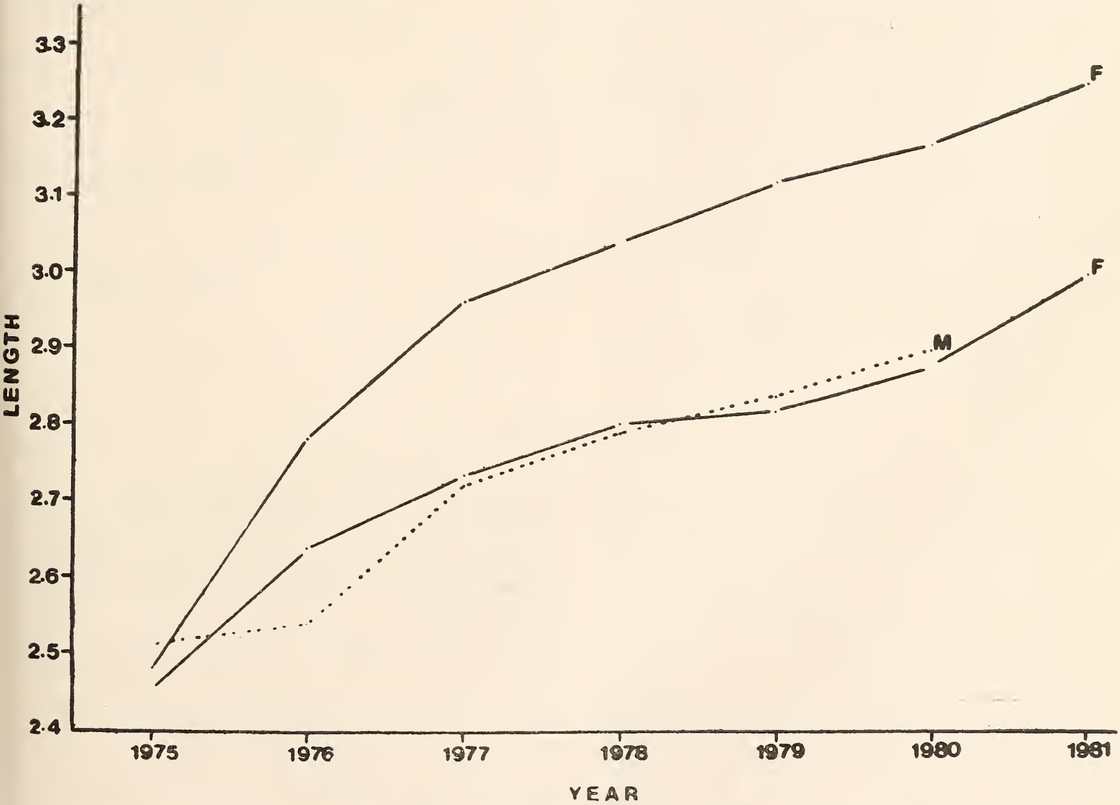

Fig. 1. Growth rates of sub-adult gharial between 1975 and 1981. F—female, M—male, length in metres. (see Table 1).

1975-76 whereas the male grew very slowly at this time. In the next year the male caught up with the second female and these two individuals grew at a similar rate thereafter. The first female, however, continued to grow more rapidly than the male throughout the study. This result is surprising, as in view of the much larger size of mature males compared to females, it is to be expected that males would show a faster growth rate. This was not shown in the present study. It may be thought that the rapid growing phase in males takes place in the early years of life and that this was already over in the case of this male when the observations commenced and it measured 2.70 m. Examination of the mean early growth rates for all three individuals using the size at time of capture together with year of capture gives a mean and growth between 1963 and 1975 of 11cm/year for the male. For the females, between their time of capture in November 1964 and November 1965 it is 14.4 and 12.5 cm/year respectively. Failure of the male and indeed all three individuals to show more rapid growth in the early years may be explained on the basis of stunting (Choudhury & Bustard, in press).

It is not suggested that the size of gharial in the wild would have been similar to those of captive individuals at the same age, since, prior to the initiation of the Government of India Crocodile Project, most gharial showed markedly retarded growth (Choudhury & Bustard, in press). But growth rates during the period 1975-81 inclusive, when the gharial were in the large breeding pool and receiving adequate diet, are thought to reflect normal growth rates for sub-adult gharial of this size, that is, an average of 10 cm/year.

We thank Dr. L.A.K. Singh and Mr. B.C. Choudhury for their advice.

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21. NOTES ON LITTLE KNOWN LIZARDS FROM JAMMU & KASHMIR STATE

The lizards under report were collected from various parts of J & K state during the years 1974—1978. Of the six reported species, 1 (*Ablepharus pannonicus*) is new to India whereas 3 (*Sitana ponticeriana, Ophisops jerdoni* and *Acanthodactylus cantoris cantoris*) have been recorded for the first time in the state of Jammu and Kashmir.

Ablepharus pannonicus Fitzinger
Mediterranean Dwarf Skink

Ablepharus pannonicus Fitzinger (1823) in Lichtenstein, in Eversmann's Reise nach Buchara, p. 145.

Material examined: (1) Near Bahu Fort, Jammu, Oct., 1978.

The genus *Ablepharus* is recorded in India for the first time. A single specimen of *A. pannonicus,* with snout vent length 30 mm, was obtained from the dry alluvial bed of river Tawi in Jammu.

Minton (1966) obtained the specimens of this species from mountainous northern sections of province from Quetta to Chitral in Pakistan. His specimens were collected at an elevation of 2133 m (7000 ft) while discussing world distribution of the species, Leviton and Anderson (1970) reported its occurrence in Iraq, northern and western Iran, U.S.S.R., Afghanistan and Pakistan. In Afghanistan, the specimens were obtained at an elevation of 2316 m (7600 ft). The single specimen examined, however, was collected at an altitude of 260 m in Jammu province of J&K state.

Sitana ponticeriana Cuvier
Fan-throated Lizard

Sitana ponticeriana Cuvier (1829) Re'gne Anim. 2nd, ed. ii, p. 43.

Material examined: (5), 3 males and 2 females, Bahu Fort, Jammu. April—August, 1978.

The Sitana lizards were collected in a dry alluvial bed of river Tawi, near Bahu Fort in Jammu. It appears to be uncommon in this part of country. It is fast runner, and takes refuge in bushes or under stones when chased. A female, with snout vent length 45 mm, collected in June had 8 oviducal eggs with an average size 8.5 mm x 4 mm.

Ophisops jerdoni Blyth
Punjab Snake-eyed Lizard

Ophisops jerdonii Blyth (1853). Asiat. Soc. Beng. xxii, p. 653. Material examined: (10) 3 males, 5 females and 2 juveniles, Jhajjar kotli, Nagrota and Bahu-Fort in Jammu; April—Nov., 1977.

Punjab Snake-eyed Lizard is a species of xeric conditions found in dry, rocky or alluvial plains along river Tawi. It is an active diurnal lizard, and was found to be quite active even during noon hours of the months of May and June when the temperature rises as high as 40°C. Though commonly seen, its speed, crepuscular nature and small size makes it a difficult species for collection. Specimens were collected from April to November, although some were seen during winter months also basking on stones. A Juvenile with a 17 mm snout vent length, was collected in the month of July.

The present collection of *O. jerdoni* showed presence of 8 to 12 femoral pores on each side. Smith (1935) described 7 to 12 femorals, rarely 6 pores on each side. Minton's (1966) collection of *O. jerdoni* from Pakistan showed

8 to 9 in males and 6 to 7 femoral pores in females. The series of collection from J & K state showed no such sexual dimorphism in the number of femoral pores. However, in males femoral pores of each side was separated by one *inter femoral scale* (scale without femoral gland) and 4-5 such inter-femoral scales in females.

Acanthodactylus cantoris cantoris Gunther
Indian Fringe-Toed Sand Lizard

Acanthodactylus cantoris cantoris Gunther (1864). Rept. Brit India, p. 73.

Material examined: (1) sex undertermined; Akhnoor, Tehsil, in Jammu, July, 1977.

This is first record of the species from state of Jammu and Kashmir. The species has been earlier recorded from Ambala, Ferozpur and Hissar, all of which lie to the south of J & K state. It seems to be a rare species in this part of the country. A single specimen was collected under stones in the plain area of tehsil Akhnoor. From the site of its collection the lizard appears to be an inhabitant of dry, rocky, alluvial bed.

The specimen collected agrees with *A. cantoris cantoris* described from Pakistan (Minton 1966) and from India (Smith 1935) except for the presence of a small occipital shield and a large triangular shield of uncertain nature lying wedged between frontonasal and prefrontal. The species exists as a single subspecies *A. cantoris cantoris* throughout its range in the Indian limit but west of longitude 60°, it may exist in other subspecific forms, like *A. cantoris blanfordi, A. cantoris schmidti* and *A. cantoris arabicus.* Of these subspecies, *A. cantoris schmidti* and *A. cantoris arabicus* have their range limited from Arabia to western border of Iran and therefore, cannot in any case be related to one available in the state.

The only other subspecies, *A. cantoris blanfordi* (Minton 1966) is distributed over the area that lies to the north and west of the range of the typical form. However, in the presence of well differentiated dorsal and lateral scale and higher count of femoral pores (31), the present form can be well differentiated from *A. cantoris blanfordi.*

Phrynocephalus theobaldi Blyth
Kashmir Toad Agama

Phrynocephalus theobaldi Blyth (1863). J. Asiat. Soc. Bengal xxxii, p. 90.

Material examined: (14), 7 males, 5 females and 2 juveniles. Leh and Kargil districts in Kashmir Province, June, 1976 and May, 1977.

The specimens were collected on the slopes of hills on the road side of Kashmir-Ladakh National Highway. The tract is almost devoid of any plant cover. A very active lizard, which when cornered assumes a threatening posture by raising its body off the ground and opening its mouth widely. It lives in burrows which are sometimes 15 cm to 25 cm deep. A montane species; specimens were collected from 3,000 m to 3,500 m in Leh and Kargil. The lizard feeds on high altitude beetles, ants and grasshoppers. The other species which have been seen in association with this lizard are *P. reticulatus, Cyrtodactylus stoliczkai, C. lawderanus, Agama himalayana* and *Scincella ladacense.*

A female collected on May, 1977 died in captivity in August of the same year. On dissecting it, 3 nearly full term embryos were recovered, suggestive of its ovo-viviparous habit.

In Indian limit, it has been recorded only from Kashmir and elsewhere from southern Tibet and East Turkestan. Prakash (1971) stated "The genus *Phrynocephalus* is being reported for the first time from India." He seems to have ignored the reports of *P. theobaldi* and *P. reticulatus* in Kashmir province by Smith (1935).

Phrynocephalus reticulatus Eichwald
Ladakh Toad Agama

Phrynocephalus reticulatus Eichwald (1831). Zool. spec., p. 183.

Material examined: (2) 1 male and 1 female; June, 1976, Leh.

Habits similar to that of *P. theobaldi* but an uncommon species. About *P. reticulatus,* Smith (1935, p. 232) recorded, "The species is included in the fauna of the Indian Empire on the strength of a single specimen in the British Museum collected by Schlagintweit brothers and said to have come from Ladakh, Kashmir. Unfortunately the localities given by these collectors cannot be relied on." The collection of 2 specimens of *P. reticulatus* from Ladakh confirms its occurrence within Indian limits.

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JAMMU-180 001,
October 1, 1981.

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P. L. DUDA

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22. ON FLYING LIZARD IN MUNDANTHURAI SANCTUARY

Flying lizards *Draco dussumieri* are fairly common in Mundanthurai along the ribbon of forests, fringing rivers Thambaraparani and Servalar. In walks along the riverside footpaths, Ficus Prop-Kanikudi Nature Trail, Rauf Ali's Bonnet Macaque study area, Glyn Davies, 'Squirrel study area and around Kodamadi Rest House region, they can be seen, if one waits and watches for them. The bright yellow dewlap projecting and disappearing helps to locate this lizard though the folded wings are difficult to see. It is easier to watch them in the plantation of Teak, Neem and Bombax just adjoining the river Servalar, when they descend down to convenient eye-level. They are found along the border plantation lines 2-5 rows of planted area parrallel to the river. On seeing one gliding in circles and landing on a planted tree 1m above ground, then running up to a height of 5-6 m then gliding down. I searched the area and located another lizard moving on the ground. One possible guess was that the lizard on the ground was a female, who had come to the ground for laying eggs.

The teak poles were about 6 m tall almost uniform in height at an interval of 11 feet while gliding the lizard turned away from the tree lifted up let itself fall on outstretched wings, resulting in a vertical fall of 1½-2m a short glide at an angle of about 45° to the tree and followed a near horizontal flight path till it landed on the next tree at a point 1½m from ground, keeping head upwards. All these took about 3-5 seconds. Slowly spiralling up as it climbed the tree. Insect population may be highest in such river border areas. Srirangan, a tracker from the local forest tribal community "kanis", said that they can be easily killed by whipping with tender branches; are roasted over a fire and eaten, younger tribals are not aware of this practice.

J. MANGALRAJ JOHNSON

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Tamil Nadu,
November 12, 1982.

23. LONGEVITY OF FISH *MEGALOPS CYPRINOIDES* (BROUSS)

(*With a text-figure*)

How long does a fish live, has been a common inquiry in ordinary parlance and has usually been replied to as 'we really do not know', though several anecdotes exist raising the longevity to 250 years as in the case of some old carps and the mythical Great Pyke of the Emperor Fredrick II of England, as recorded by Norman (1931). The same author quotes Dr Roger that "Statements concerning most of the very old carps rest on unreliable evidence and although there is good reason for believing that in artificial conditions this fish may attain a good old age, it is doubtful whether it exceeds 50 years in a wild state." Lagler *et al.* (1977) also records the probable long life of carps as about 50 years. This uncertainty persists because of lack of any reliable data. However, available records in the Fisheries Department of Maharashtra and my own observations at Lonavla have provided dependable information about longevity of *Megalops cyprinoides.* This is being recorded here.

The fish is, as many would know, a marine one, the larvae and young ones of which enter brackish water and then into fresh water, to feed on the rich animal life, till they grow upto about 15 cms and then return to the sea for further growth up to about a metre. Its near cousin is the great tarpon which inhabits estuaries of northern America. If the seaward movement of *M. cyprinoides* is obstructed they remain for long years in fresh water, but do not breed. In July 1939, the Fisheries Section of the then Department of Industries decided to stock fingerlings of Catla Rohu, Calbasu, etc in different perennial waters of the then Bombay Presidency in which Walwhan and Shirota lakes of Tata Hydro-Electric Company were included (vide annual report of the Department of Industries, Fisheries Section 1939-40). As the fingerlings of *M. cyprinoides* were also found to be very efficacious in controlling cyclops, an intermediate host (carrier) of the dreaded quineaworm pest (Setna & Kulkarni 1940), one of the consignments which completed the tally of 10,000 fingerlings for these lakes consisted of *M. cyprinoides* and was released into the lakes by me. Another reason for this introduction was reported pre-eminence of this fish for angling. The fingerlings thrived in the protected water of Walwhan lake, extending to as much as 650 hectares at full supply level and continued to do so even in the years when the lake reached zero sill level, surviving in the dead storage which was enough for the hardy fish.

Time went on without any incident as fishing with nets was never permitted in these lakes and no fresh stocking was done. When netting was undertaken in 1970 for catching gravid mahseers for artificial breeding (Kulkarni 1971), a few *M. cyprinoides* were also caught. The occurrence of this fish in the lake in that year indicated its survival over the years and was described as an example of extreme tenacity of the fish. The incident was also noted for the fact that those who ate the fish cursed us for giving them tasteless fish with rubber like flesh. The rubberoid condition of the flesh, when cooked, was probably due to long years of age (32 years) without substantial increase in size which was only 65 cms in total length and 2.8 kg in weight. A few fish of almost the same size were caught every year but never any young ones, because the fish being a marine type does not breed in fresh water. They were peculiar in being found dead in the nets though the mahseers and others were found alive. This was because of the special feature of the fish in having an accessory respiratory

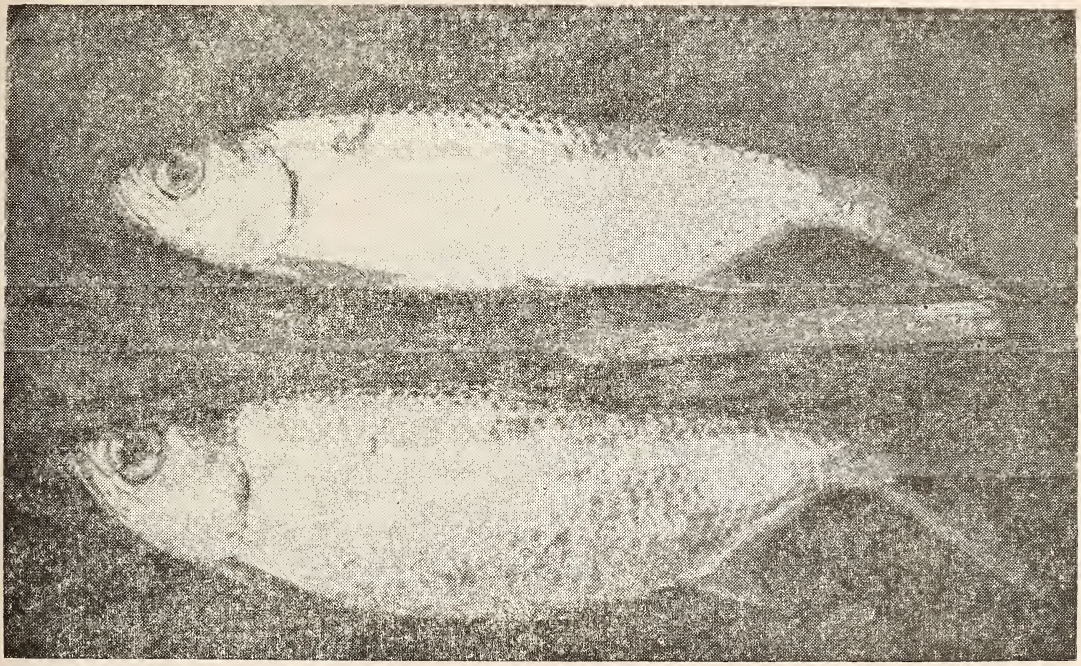

Fig. 1. 44 year old fish *Megalops cyprinoides* (Brouss).

organ in the shape of vascular bands on the inner walls of its air bladder which enable it to utilize direct surface air for its respiration. When the fish is prevented from reaching the surface, being caught in the nets, it drowns and dies. Other fish which take oxygen dissolved in water can remain struggling. During a trial netting on August 19, 1983 some more fish were caught in similar circumstances. They were 67 cm in total length and varied from 2.75 to 3.1 kg in weight. Gonads were inconspicuous. This record gives reliable data that *M. cyprinoides* is capable of living for at least 44 years in fresh water in wild conditions and grow to the length and weight mentioned above. They were so healthy that they appeared capable of living for another 8 or 10 years. Further records would therefore be interesting to assess the longevity of this fish but one can assert from this record that the fish can live at least for 44 years.

B/4, SHARDASHRAM,
BHAWANI SHANKAR ROAD,
DADAR, BOMBAY 400 028,
August 29, 1983.

C. V. KULKARNI

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24. EXTENSION OF RANGE OF THE DADIO, *CHELA* (*NEOCHELA*) *DADIBURJORI* (MENON) (PISCES: CYPRINIDAE)

(*With a text-figure*)

In 1951, A. G. K. Menon published an account of a new species of fish from Cochin. His description was based on a few specimens sent to the Zoological Survey of India by the veteran aquarist, the late Mr. Sam J. Dadyburjor.

The fish, named by Menon as *Laubuca dadiburjori* after this aquarist, is closely related to the species *maassi* from Sumatra, even to the extent of fin-ray count. The fin-ray formula is :—

D. 2/7, A. 3/11, P. 1/7, V. 1/5, C. 19; L. 1. 30-34, L. tr. 7.

Laubuca dadiburjori, now called *Chela* (*Neochela*) *dadiburjori*, can be distinguished in having a lateral steel blue stripe running along the middle of the body, extending from the angle of the opercle to the caudal peduncle, and a band of the same colour along the dorsum from the base of the dorsal fin to the occiput. On the lateral body stripe are three to four dark dots in the adult and as many as six in the juveniles. In adult females these dots diminish considerably in size until they are almost inconspicuous along the dorsal stripe. This is clearly seen in the colour photograph in Axelrod *et al.* 's (1967) book on page 365. Above the dark stripe is a thin golden stripe. The dark stripe and dots turn black on preservation. The lateral line is incomplete. The fins are transparent with a yellowish tinge. The body in the female is colourless and transparent except for the silvery sheen over the viscera, but the adult male has a suffused yellow coloration all over the body.

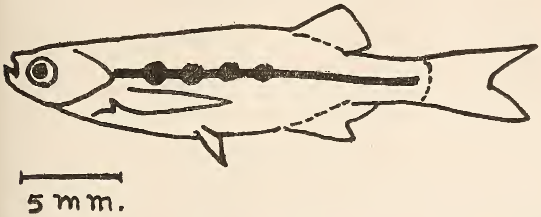

Fig. 1. *Chela* (*Neochela*) *dadiburjori*; adult.

The fish is diminutive in size, growing only to 30 millimetres in the adult female, and a few millimetres less for the male. It is a popular pet in the home aquarium, where it is known as "dadio", or sometimes as the Indian glass barb (Frank 1979, page 177). Incidentally, the photograph in Frank's book (page 176) is not of *Chela* (*Neochela*) *dadiburjori*, and his statement that the fish grows to a length of four to five centimetres is also incorrect. His measurements and photograph are of the flying barb (*Esomus danricus*), as can be made out from the long pectoral fins and the very long barbels below the chin seen in his photograph.

In the course of our collection of fishes from peninsular India over the last twenty years, we have continually collected live specimens of this species from Nagercoil in Tamilnadu State, and from Sanguem in Goa. Nagercoil (8° 3′N, 77° 40′ E), which is situated just north of Cape Comorin, is about 230 kilometres (as the crow flies) south of Cochin (9° 43′ N, 76° 13′ E), and this constitutes an extension of range southward for *Chela* (*Neochela*) *dadiburjori*. Similarly, Sanguem, which is over 615 kilometres north of Cochin, constitutes a considerable extension of range for this fish. From our findings of this fish from such widely separated places, it can be assumed that *Chela* (*Neochela*) *dadiburjori* may be inhabiting suitable water stretches throughout the area between the two aforestated places. However, while collecting *Puntius melanampyx* from Mundakayum, Kottayam and Quilon, we did not come across any specimens of this fish.

Axelrod *et al.* (loc. cit.) put Menon's name in parentheses after the name of the fish, then known as *Laubuca dadiburjori*. This is incorrect according to the international rules of Zoological nomenclature, as Menon had attributed this fish to the genus *Laubuca*. They have also given the geographic distribution of the species as "vicinity of Bombay". This is erroneous and is probably based on the fact that these fishes are exported from Bombay airport in the international aquarium fish trade. Such statements based on assumption, and published in non-technical literature and popular books, unfortunately lead to ichthyologists subsequently quoting these earlier sources as authoritative, leading to confusion about the true geographic distribution of the species. This has happened in the present instance, where Frank (1979) has wrongly followed Axelrod *et al.* 's (1967) distribution of this fish.

"SACHETAN",
L/4-5, SITARAM BUILDING,
PALTON ROAD,
BOMBAY-400 001.
E-31, CUSROW BAUG,
COLABA CAUSEWAY,
BOMBAY-400 039,
December 30, 1981.

S. R. SANE

B. F. CHHAPGAR

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25. AN INTERESTING METHOD OF FISHING IN DHANBAD DISTRICT, BIHAR

(*With a text-figure*)

In connection with our studies on fishes of Bihar, one of us (G.M.Y.), while making faunistic survey of River Barakar during June, 1981, came across an interesting method of fishing at Madrussa ghat (R. Barakar) *c.* 6 km. north of Tundi (Distt. Dhanbad). The method essentially consists of a pot-trap—an aluminium bowl, *c* 10 cm diameter, on top of which a piece of cloth is tied around. A few holes are made in this cloth and a small quantity of baked and coarsely ground seeds of white millet ("Jowar", *Sorghum vulgare*), *Kundrung* (*Bibiscus sabdariffa* L.) (Malvaceae), and *Sarguja* (*Guizotea abyssynica* Cass. (Compositae) mixed in 4:1:1 proportion, respectively, are placed in the bowl. The bowl is set in a depression in the sand in such a way that the cloth surface is almost level with sand around it (Fig. 1).

This method is operated in shallow, running waters where the bottom is generally sandy. As the bowl is left under water, all fish available in the vicinity get attracted towards the bowl owing to presence of ground seeds which act as bait, and finally enter the bowl through the holes. When a number of fish have gone in they fail to come out, presumably due to panic (Faruqui & Sahai 1943). The bowl is now taken out of water and fish removed to a fish basket. The operation is repeated as long as fish are available in sufficient number, otherwise the trap is shifted to a new spot.

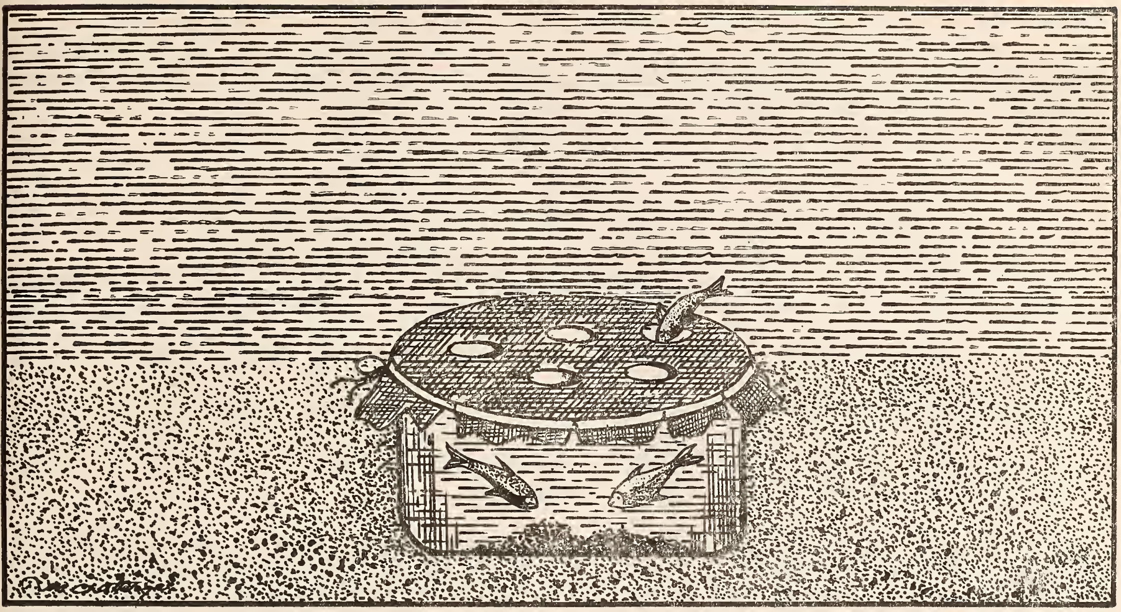

Fig. 1. The pot-trap in operation.

This method of fishing is quite efficient, for about half a dozen small cyprinids belonging to genera *Puntius*, *Salmostoma* and *Barilius* were caught in one operation. The smell from ground seeds—the bait, appears to play an effective role in attracting fishes towards the trap and for directing them into the bowl; *Sarguja* seeds are known to yield an oil used as an article of food (Haines 1922).

Of the various methods employed for catching fishes, netting and angling are the most popular. While angling is practised by using different types of bait, various modifications of netting have also come in vogue. The method described above is a trap, resembling the pot-trap described by Faruqui & Sahai (1943) from Uttar Pradesh. However, the pot-trap from U.P. consists of a flat earthen vessel with raised walls, on top of which a piece of cloth is tied around. A few holes are made in the cloth and some flour pills are placed inside to attract fishes. We have not so far seen the earthen trap net described by Faruqui & Sahai (1943) being used in Bihar.

We are thankful to Dr. V. S. Agrawal, Botanical Survey of India, Calcutta, for the identification of seeds.

Zoological Survey of India,
Gangetic Plains Regional Station,
Patna-16,
October 21, 1981.

G. M. YAZDANI
P. D. GUPTA

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26. FIELD OBSERVATIONS ON THE OCCURRENCE OF *MICRONECTA SCUTELLARIS* STAL. (HEMIPTERA: CORIXIDAE)

(*With a text-figure*)

The water bug, *Micronecta scutellaris* Stal. is very common in stagnant water in ponds, pools and ditches. Abundance of this bug was observed in the three ponds of Aligarh district and was found to be influenced by the increase in percentage of organic matter in the water. Alkalinity of water beyond pH 8.5 has an adverse effect on the population density of *M. scuttellaris*. The temperature within the observed range (16.5-32.3°C) did not affect the occurrence of this species.

INTRODUCTION

Micronecta scutellaris Stal. (Fam: Corixidae) is usually found in stagnant water in ponds, pools and ditches in many parts of the world almost throughout the year (Butler 1923). *M. scutellaris* and several other species of the family Corixidae are the preferred food of poultry, cage birds and fishes in many countries. In Mexico, the eggs are collected by placing reeds in the water (Aucona 1933) and are used as human food (Hungerford 1948). In view of this importance it was considered desirable to study the distribution of *M. scutellaris* under Indian climatic conditions and also the environmental factors that determine their abundance.

MATERIAL AND METHODS

The abundance of *M. scutellaris* was studied over a period of twelve months from October 1971 to September 1972 in three different ponds in Aligarh. One of these Nilichhetri pond is about 30.0 metres in length and 10.0 metres in width. The second was Jamalpur pond which is about 25 x 8 metres in area. The main source of water in these ponds is rain. The polytechnic pond, the third is small, spherical, cemented and about 5 metres in diameter and largely has tap water.

The bugs were collected from the ponds with a hand net on every Sunday. On each sampling day two collections were made, one at 8.00 hr and other at 16.00 hr. Each sample was subjected to differential numerical analysis and mean of all the counts, made for all samples collected during a month in a Centre, was taken as representing the monthly average and plotted against the respective month. The percentage of organic matter in the soil was measured by the ignition of dried samples. Temperature of the water was noted and pH was determined by means of pH paper on the spot during each collection.

RESULTS AND DISCUSSION

The various hydrological features at sampling sites during the period of study are given

TABLE 1
MONTHLY FLUCTUATION IN VARIOUS HYDROLOGICAL FEATURES AT SAMPLING SITES

	% o.m.s.				Temperature °C			pH		
		Jamal. pond								
Month	Nil. pond	Drain end	opposite end	Poly. pond	Nil. pond	Jamal. pond	Poly. pond	Nil. pond	Jamal. pond	Poly. pond
Nov. 1971	4.9	15.9	11.3	3.6	20.6	20.5	20.5	7.5	7.7	7.7
Dec. 1971	5.9	16.3	11.1	3.9	16.5	16.8	16.6	7.3	8.6	8.2
Jan. 1972	6.3	16.5	10.9	4.3	16.3	16.8	16.6	7.5	8.5	7.9
Feb. ,,	5.6	16.5	11.3	4.8	17.0	16.8	17.2	7.9	8.7	8.1
March ,,	6.4	15.8	11.5	4.6	22.8	23.3	23.6	8.7	9.5	8.0
April ,,	6.9	15.8	11.1	5.3	27.8	27.5	28.0	8.4	9.7	8.2
May ,,	7.6	19.5	11.3	4.8	29.3	29.0	30.0	8.3	8.8	9.0
June ,,	8.1	17.3	10.8	5.6	29.5	29.0	30.1	8.4	8.7	8.7
July ,,	8.2	16.7	11.5	5.3	30.1	29.1	30.5	8.1	8.3	8.3
August ,,	7.6	16.7	10.9	4.4	32.3	32.0	32.3	7.6	7.7	8.3
Sept. ,,	8.0	16.5	11.4	4.9	31.0	31.0	31.6	8.1	8.2	8.5
Oct. ,,	7.9	16.8	11.1	4.9	27.9	28.6	28.1	8.3	7.8	8.1

in table 1. The seasonal abundance of *M. scutellaris* in these ponds is presented in Fig. 1 The results obtained showed that the amount of organic matter and pH of water can affect the population density of *M. scutellaris,* while temperature, within the observed range, was not found to be the determining factor of the seasonal abundance of *M. scutellaris.*

Effect of organic matter:

The percentage of organic matter in an aquatic soil has been shown to be an important factor in the distribution of certain species of Corixidae (Macan 1938). During the present observations, the percentage of organic matter of Nilichhatri pond ranged from 4.9 to 8.2 while it was 10.8-19.5 per cent in Jamalpur pond. As polytechnic pond is small, cemented and mainly filled with tap water, the % o.m.s. was very less and ranged from 3.6 to 5.6. The population density of *M. scutellaris* was observed the highest in Jamalpur pond throughout the year. This may be due to high percentage of decaying organic matter especially at a point where human and animal excrements were drained into the pond. This fact was further confirmed by making collection from the drain end and the opposite end of the pond. Due to higher percentage of organic matter at the drain end (15.8-19.5) than at the opposite end (10.8-11.5) the population of *M. scutellaris* was significantly higher at the drain end.

The population density of *M. scutellaris* was directly proportional to the percentage of the organic matter present in the water. The percentage of organic matter was 16.6, 6.95 and 4.68 in the water of Jamalpur, Nilichhatri and Polytechnic pond respectively and consequently the population density of *M. scutellaris* was the highest in Jamalpur pond and then in Nilichhatri and Polytechnic ponds (Fig. 1). This confirms my earlier findings (1977), that decaying organic matter, is the most preferred food for oviposition and development of the nymphs of *M. scutellaris.*

Effect of temperature:

A number of workers including Allen (1920), Prasad (1956) and Byars (1960) have reported that temperature is the determining factor in seasonal distribution of organisms. During the present studies temperature of the water

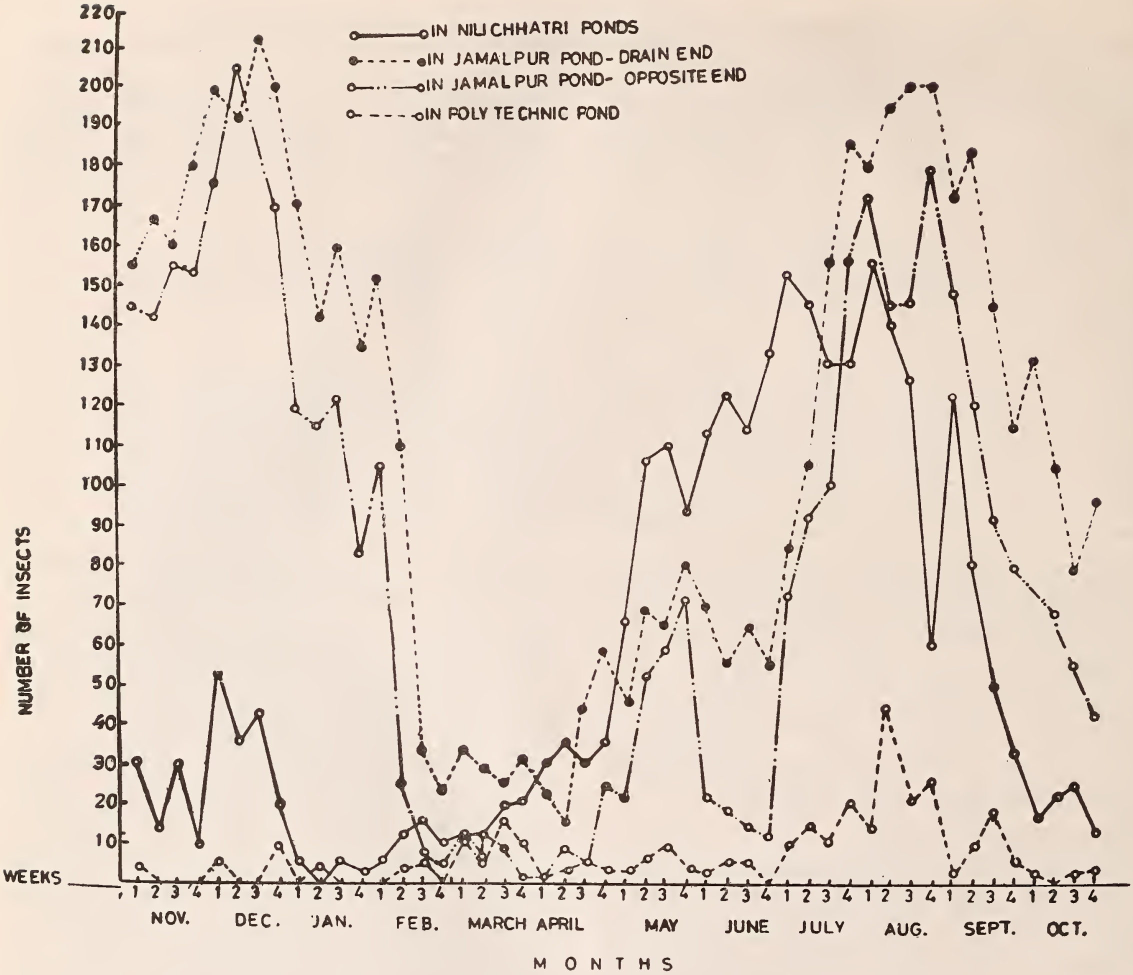

Fig. 1. Seasonal abundance of *Micronecta scutellaris* in different ponds.

of various sampling ponds ranged from 16.3° to 32.3°C. (Table 1). This range of temperature did not appear to determine the population density of *M. scutellaris.* The population of this species was sufficiently high in Jamalpur pond during the hot days of August (Temp. 32.0°C) and cold days of December (temp. 16.8°C). Therefore, during the present studies temperature, within the observed range of 16.3°-32.3°C did not affect the population density of *M. scutellaris.*

Effect of pH: Devic (1954) believes that pH is the most important chemical factor affecting the abundance of living organisms in the water. During the present studies pH of the water had a marked effect on the occurrence of *M. scutellaris.* Alkalinity of the water beyond pH 8.5 proved to be unsuitable for the occurernce of this species. During the period from February to June the water of

Jamalpur pond was alkaline and the pH ranged from 8.7 to 9.7 (Table 1), consequently the number of *M. scutellaris* was greatly reduced despite high percentage of organic matter. During this period abundant green algae appeared in the pond. The increase in pH might be due to rise in carbonate alkalinity resulting from photosynthetic activity of the algae (Unni 1972). Higher level of pH causes respiratory distress in the population of aquatic animals (Erichsen 1964). The observations confirm the earlier findings of Thornton and Wilhm (1974) who observed significantly lower survival of *Chironomas attenuatus* i.e. 0.92 per cent at a pH of 8.2 while the survival was 5.94 and 5.98 per cent at pH 6.2 and 7.2 respectively.

ACKNOWLEDGEMENTS

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27. SYSTEMATICS OF UNDESCRIBED MALES OF SOME THYSANOPTERA FROM INDIA

(*With four text-figures*)

The present paper includes detailed description of so far undescribed males of *Streothrips arorai* (Bhatti), *Ernothrips lobatus* (Bhatti), *Areothrips longisetis* Anan., and *Androthrips flavitibia* Moulton.

1. **Streothrips arorai** (Bhatti)

(Figs. 1-3c)

Aeolothrips arorai Bhatti, 1967, *Thysanoptera Nova Indica* 4-5.

Streothrips arorai Bhatti, 1971, *Oriental insects* 5(1: 83-90.

Originally this species was described from only one female. Males smaller than females. The males agree with females in colour range but prothorax, fore legs and middle femurs yellow; distal two third of hind femurs, extremes of middle and hind tibiae, middle and hind tarsi are greyish brown.

Head wider than long, 154-157 long[1], 185-198 across eyes, 205-210 across genae and 190-195 at base. Antennal segments, length (width); 31-34 (33-34); 51 (28); 100-105 (25-26); 98-100 (25-27); 72-75 (25-27); 11 (16); 9 (14); 8 (8); 8 (5). Segment II orange yellow. Sensory areas on segment III 33-36 long and on IV segment 47-49 long. Maxillary palpi; i, 42-45; ii, 28-30; iii, 8-10 long.

Prothorax 154-155 long and 230-240 across middle and 140-150 across base. Fore wing 700-750 long and 100-120 wide in the middle. Hind wing 650-680 long and 80-100 wide in middle. Middle tibiae 180-190 long and hind tibiae 230-235 long.

Abdomen 120-130 at base, 220-230 across middle and 80-90 across X tergite bears three pairs of bristles, the inner pair of bristles curved outwardly. Segments II to V bear two pairs, VI to VII with three pairs and VIII with four pairs of acessory setae. Phallus 112 long.

Total body length: 1.40 mm - 1.50 mm.

Material: 5 ♀♀, 3 ♂♂ from flowers of *Cassia fistula* and *Pongamia glabra*, Shasradhara, Dehra Dun on 12.6.1978, 3 ♀♀, 2 ♂♂ from *Aleurites* sp. and a wild shrub, Dehra Dun on 5.5.1979, Coll. Vijay Veer.

2. **Ernothrips lobatus** (Bhatti)

(Fig 4)

Thrips (*Ernothrips*) *lobatus* Bhatti, 1967, *Thysanoptera Nova Indica*, 18 pp.

Ernothrips lobatus Bhatti. 1969. *Oriental Insects* 3(4): 373-382.

The original description of this species is only from one female.

The male differs from female, besides other characters, in being smaller in size and coloration. Body orangish-yellow. Antennal segments IV to VII are brown. Forewings brownish being darker at middle.

Head 78-80 long, 112-117 across eyes, 120-130 across genae, 126-133 across posterior margin. Mouthcone 82 long, Eyes 50-56 long, 39-45 wide, 42 apart from each other. Antennal segment: length (width): 18 (19); 28 (21); 33 (14-16); 28-30 (15); 26-28 (14); 35-39 (14); 14 (17).

Prothorax 106-108 long, 156-160 across middle postangulars; outer 19-23, inner 31-34. Pterothorax 106-208 long, 196-200 across mesothorax, 179-180 across metathorax. Fore wings

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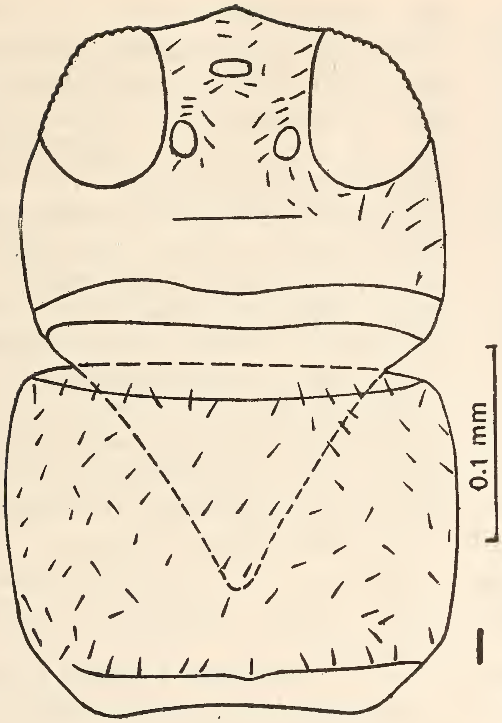
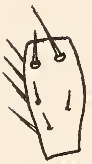
[1] All measurements in microns unless otherwise mentioned.



1



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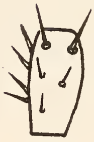

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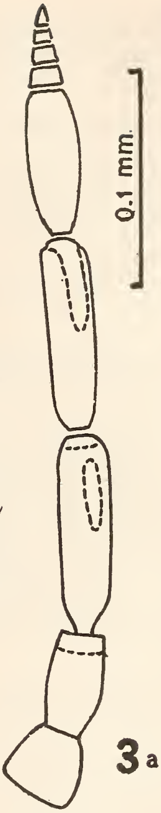

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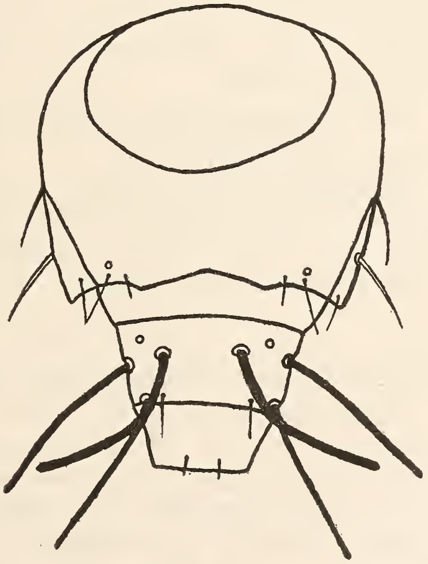
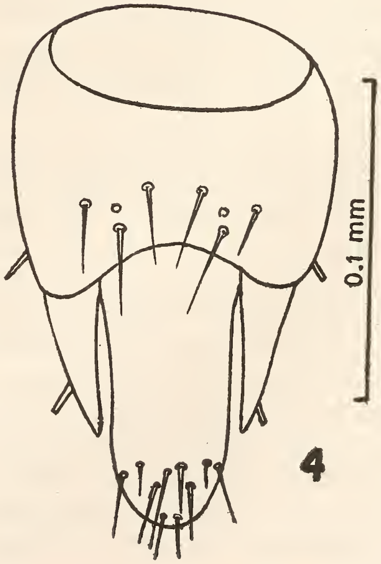


2



4

Figs. 1-3c. *Streothrips arorai,* ♂: 1, head and prothorax; 2, terminal abdominal segments, dorsal view; 3a, Antenna, dorsal view (microtrichia omitted); 3b, antennal segment II, dorsal view, showing chaetotaxy; 3c, antennal segment II, ventral view.

Fig. 4. *Ernothrips lobatus*: 4, terminal abdominal segments of ♂, dorsal view.

420-450 long, 31-33 across middle. Costa with 19-24 setae, upper vein with 4+3+2 setae, lower vein with 9-10.

Abdomen 103-110 across base, 126-130 across middle, 64-70 across X segment. Phallus 84-92 long. Terga and sterna of II-VIII with postmarginal flange but that on sterna produced into a fine comb.

Total body length: 80-90 mm.

Material: 10 ♀♀, 6 ♂♂ from flowers of *Lantana camara* Shasradhara, Dehra Dun, on 15.9.1978, 20 ♀♀, 12 ♂♂ from flowers of *Mallotus philippinensis,* Dehra Dun on 15.10.1978, Coll. Vijay Veer.

3. **Araeothrips longisetis** Ananthakrishnan

Araeothrips longisetis Ananthakrishnan, 1976, *Proc. Indian Acad. Sci.* 83 B(5): 202-204 (Holotype ♀ and paratypes 14 ♀♀ from Kanha Reserve Forest, Madhya Pradesh, India, 20.1.1970).

This species has been described by Ananthakrishnan (1976) on the basis of females.

Macropterous Male: General body colour similar to females. Body brown except distal one third of fore femora, all tibiae, all tarsi and antennal segments 3-8 (except the tip of VIII which is slightly darker), pale. Wings infumate, base and scale more yellowish. All setae greyish, blunt.

Head wider than long, 134 long, 140 across eyes, 154 across genae, 148 at base. Eyes 56-58 long, 33-35 wide; median ocellus 9 wide, Paired ocelli 11-12 wide and apart from each other 47. Mouth cone short, 61 long, broadly rounded, 126 wide at base and 50 wide at apex. Maxillary stylets widely separate and refracted into head about the level of the postoculars.

Postoculars 45-47, placed 103 apart from each other. Antennal segments, length (width); 17 (31); 36-37 (22); 36 (17); 25-27 (19); 28 (20); 25 (19); 28 (14); 39-42 (9). Sense cones on 3 and 4 10-14 long; Sense cone formula 3^{1+0}, 4^{1+0}, 5^{1+1}, 6^{1+1}.

Prothorax wider than long and shorter than head, 92 long, 168 wide across anterior margin and 184 across posterior margin. Anteroangulars and anteromarginals weak 3-6 long; midlaterals 42-43, postangulars 76-80 and epimerals 48-50. Fore femora simple, 84-86 long, 44-46 wide, tarsi armed. Fore wings 450-460 long, 11-13 wide at middle with 3-4 double fringes. Basal wing setae 5, 6-7, 14-16 long. Pterothorax 196 long, 217-219 across mesothorax, 223-225 across metathorax.

Abdomen 145 across VIII, 100 across IX; B_1-B_3 of IX 87-89, 16-18, 84-86 long. Tube 75 long, 42, 45, 28 wide respectively at base, middle and apex; anal setae 110-115 long.

Total body length: 1.00 mm.

Material: 2 ♀♀, 2 ♂♂ from leaves of wild plant, Tapoban, Dehra Dun on 10.4.1979, Coll. Vijay Veer.

4. **Androthrips flavitibia** Moulton

Androthrips flavitibia Moulton, 1933. *Indian Forest Records,* XIX (1): 1-2 (Holotype ♀ from New Forest, Dehra Dun, U.P.). *Androthrips flavitibia,* Ananthakrishnan; 1964, *Opusc ent.* Suppl. 25:31.

This species has been described from one female by Moulton (1933).

Macropterous male. Smaller in size than females. Colour range agree with that of female; body dark brown except all tibiae, all tarsi and III-VI antennal segments clear yellow; fore femora yellowish brown in distal one third; sometimes antennal segments VII also brownish yellow in distal one third. Wings clear.

Head longer than wide, 115-204 long, 129-151 across paired ocelli, 143-145 across genae, and 120-145 across base. Eyes 45-48 wide, 67-75 long, 48-56 apart from each other. Median ocellus 14 wide, 17 apart from paired ocelli; 30-31 wide and 28-29 apart from each other; postoculars 53-70 long. Mouth cone 72-84 long and 48-53 wide across tip. Antennal segments, length (width); 14-16 (28-31); 31-38 (26); 50-59 (31); 60-62 (28-31); 42-53 (22-25); 39-45 (19-22); 36-42 (14-17); 28-35 (8). Sense cones 28-30 long.

Prothorax 120-140 long, 168-184 wide across anterior margin, 234-260 across posterior margin. Anteroangulars 37-58, anteromarginals minute, midlaterals 36-58, epimerals 53-77, postangulars 50-75, Fore femora broad, 84-123 wide inclusive of tooth; width of fore tibia at apex, inclusive of scale 36-44.

Pterothorax longitudinally reticulate, with a minute pair of setae at middle, 22-25 long. Fore wings 600-750 long with 5-7 double fringes; basal wing bristles 42-56, 44-58 and 67-100 long respectively, the first two little expanded, the remaining one knobbed.

Abdomen 92-98 wide across middle of IX segment, B_1-B_3 bristles of IX segment 95-117, 20-31, and 126-154 long. Tube 117-140 long. 39-50 wide at middle; anal setae 110-182 long.

Total body length: 1.40-1.70 mm.

Material: 10 females and 5 males from galls of *Mallotus philippinensis* and *Casearia tomentosa* on 18.5.1979 and 25.4.1979 respectively from Raipur, Dehra Dun District, Coll. Vijay Veer.

ACKNOWLEDGEMENT

We are thankful to Prof. T. N. Ananthakrishnan, Director, Zoological Survey of India for help. Thanks are also due to Dr. S. K. Sangal, Head of Zoology Department for providing laboratory facilities and encouragement.

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August 6, 1980.

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28. STUDIES ON KASHMIR HIMALAYAN UMBELLIFERAE III — SOME NEW RECORDS

Umbelliferae (now Apiaceae) is cosmopolitan in distribution with maximum diversity in northern hemisphere particularly in Central Asia and the Mediterranean region. The latter for sufficient reasons is regarded as the primary centre of umbellifer diversity (Mathias 1965). Located as they are in mid-northern latitudes in physical contiguity with the centre of origin, Kashmir Himalayas too support a respectable number of umbellifers (Hamal & Koul 1981) which have been listed and/or described from time to time by several explorers. Exploratory trips undertaken to various parts of Jammu and Kashmir state have brought to light four taxa so far not known from this region. These are, *Hydrocotyle sibthorpoides* Lam., *Scaligeria stewartianum* (Nasir) Nasir, *Torilis arvensis* (Hudson) Link. and *T. stocksiana* (Boiss) Drude. While *Hydrocotyle sibthorpoides* represents a new record for Jammu & Kashmir state, the remaining three are new records for India, and distribution notes of these species form the text of the present communication. Voucher specimens of all the four new records have been deposited in the Herbarium of Biosciences Department of the University of Jammu Under No.'s. IAH, 103, 202, 203, 401, 182, 402, 90, 151, 78, & 74.

Hydrocotyle sibthorpoides Lam. Encyl. 3; (1879): Nasir. Fl. W. Pak. 20 (1972).

Plants herbaceous and glabrous; stem creeping; abaxial leaf surface scarcely pubescent; involucral bracts absent; flowers 3-9 per umbel, subsessile, greenish-white in colour; fruit suborbicular, compressed laterally, each mericarp has five primary ridges of which dorsal and intermediate are far more prominent than the laterals; furrows wider in centre and narrowing towards poles. Flowering time May-September.

Distribution: The species is widely distributed in tropical Asia, India, China, Japan and Europe. In Kashmir Himalayas, it is abundant on the grassy banks of water bodies, brooks and channels. Place of present collection: Nishat Garden, Srinagar (IAH, 103).

Scaligeria stewartianum (Nasir) Nasir Fl. W. Pak. 20 : 79 (1972).

Plants 15-60 cm tall, glabrous and branched; root stock globose; radical leaves 2-3 pinnate, segments filiform-linear, upper leaves sessile; involucre absent; umbel rays 5-10; involucel of 3-5 minute, white margined bractlets; flowers white; fruit ovoid, subdidymous, each mericarp has five obtuse and hispid primary ridges that run from base to apex, commissural face of mericarps grooved. Flowering time, April-May.

Distribution: The species was first described in 1963 by Nasir under the name *Bunium stewartianum* from plants collected from Kahuta Road near Rawalpindi in Pakistan. So far the species is known only from northern foot hills of that country. In Jammu and Kashmir state, the species is distributed south of Pir Panjal range, 600-1,200 metres above sea level. Places of present collection : Poni Parkh (IAH 202), Kangri (IAH 203) and Ram Nagar (IAH 401).

Torilis arvensis (Hudson) Link; Enu. Hort. Berol. Alt. 1 : 265 (1821) Tutin; Fl. Europ. (1968)

Plants 30-90 cm tall, erect; leaves 1-2 pinnate, segments lanceolate, coarsely toothed; involucre mostly absent, rarely one; rays 4-6; involucel of linear bractlets; flowers white; fruit oval-oblong, compressed laterally, each mericarp bears five primary ridges and an equal number of alternating, strongly developed secondary ridges, the former bear two rows of papillate hairs while the latter carries spines at right angles to fruit surface; mature mericarps 4.0 x 2.0 mm, commissural face 0.25 mm broad. Flowering time, February-April.

Distribution: The species is widely distributed in the Mediterranean region and Europe. There is a solitary report of its occurrence in Pakistan. In Kashmir Himalayas the species abounds in the lower foot hills around Jammu city. Restricted distribution in Kashmir Himalayas indicate that the species represents recent introduction to this area. Places of present collection; Bahu Fort, Jammu (IAH 82), Poni Parkh (IAH 402).

Torilis stocksiana (Boiss) Drude. In Engl. Das Pflzn. (1898).

Plants 25-80 cm tall and hispid; leaves 1-2 pinnate, pinnae dissected,; ultimate segments oblong-lanceolate; peduncles long, leaf opposed; involucral bracts absent; umbels 2-6 rayed, rays unequal, densely pubescent at base; involucel of 5-7 linear bractlets; flowers white; fruit oblong-elliptical, mericarps laterally compressed with a narrow (0.5 mm broad) commissural face, each mericarp bears five primary ridges that are clothed with a row of papillate hairs, secondary ridges present in between the primary ridges bear 2-3 rows of straight, hard and glochidate spines; mericarp 5.0 x 1.5 mm in size. Flowering time, February-April.

Distribution: The species is so far known only from Iran (Mediterranean region). In Jammu and Kashmir state, it is distributed from subtropical regions of Jammu (IAH, 90) and Udhampur (IAH, 151) to outer hills of Rajouri (IAH, 74) and Poonch (IAH, 78).

ACKNOWLEDGEMENTS

We are thankful to Dr. S. L. Jury (University of Reading, Reading, U.K.) for help in confirming identification of *Torilis* species. Financial assistance received from CSIR, New Delhi, is gratefully acknowledged.

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July 14, 1981.

29. PHENOTYPES OF SANDAL (*SANTALUM ALBUM* L.)

INTRODUCTION

Santalum album L. exhibits plenty of variations and earlier workers attempted to categorise them into certain types. As early as 1874, Roxburgh found a variety of sandal growing in Northern Circars which was quite different from the normal sandal and described it as a separate species *Santalum myrtifolium*. De Candolle (1856) believed it to be a variety of *Santalum album* L. Brandis however united them into one species namely *Santalum album* L. and this was followed by Hooker (1890) in his Flora of British India. Lushington (1900) believed them to be two distinct species. Badami and Venkata Rao (1930) studied the variations found in the *Santalum album* L. and explored the possibilities of distinguishing different types. Griffith (1937) described a peculiar variety of sandal occurring in the Noganur R.F. of the present Hosur Division (Tamil Nadu). It had all the outward characteristics of spiked sandal but otherwise remaining healthy and bearing flowers and fruits.

With this back ground, investigations were carried out in this centre to find out the occurrence of distinct phenotypes in the natural populations. Though, based on various morphological characters, a number of phenotypes could be recognised. So far this centre has been able to distinguish three definite phenotypic populations and they are described below.

DESCRIPTION OF PHENOTYPES

1. *Thindlu type of sandal*:

This type is characterised by small diameter class trees around 4 to 8 cm dbh with a dark brown bark which comes out in irregular flakes. The most distinguishable character is that the sapwood thickness is very narrow 2 mm to 10 mm. The heartwood is dark brown in colour with distinct annual rings. It appears to be slow grown as the trees with 8 cm dia. show around 25 to 30 annual rings. To conserve this gene resource protection measures have been undertaken.

Occurrence: This type was first found in the Thindlu reserve in Hoskote range of Bangalore Division, Karnataka state and hence the name. In this place, besides this type, other types of sandal also occur in small percentage. It also occurs in other nearby reserves of Hoskote Range, in Vakkaleri reserve of Kolar Division, Ammanakatte forest of Hassan Division of Karnataka state and Valliyur R. F. of Kallakad wild life Division of Tamil Nadu.

2. *Chickballapur type of sandal*:

This type is characterised by the presence of small bluish green leaves with sparse crown. This tree resembles more or less a spiked plant and probably may correspond to the Noganur type of sandal described by Griffith (1937). Unlike Thindlu type the sapwood thickness is not narrow.

Occurrence: It occurs in Kamasettyhalli reserve, Chickballapur Range of Kolar Division and in some reserves of Shimoga Division, Karnataka State.

3. *Robust type of sandal*:

These populations usually have a compact crown with lush green foliage. The stem is usually straight and cylindrical with rust brown smooth bark having very thick sapwood (around 5 cm). This appears to be fast growing as compared to all other types as seen in even aged plantations.

Occurrence: This occurs as individual trees or in groups in most of the sandal bearing areas and can be readily recognised by the above characters. In the Srinivasapura S. F. of Kolar Division this is the most predominant type.

Besides looking for other distinct types, intensive studies on the above three types are being done. The studies include morphological, cytological and biological investigations which are likely to establish the correct taxonomical identity. In addition to establishing the taxonomical identity of these phenotypes studies on their performances in different eco-climatic regions are also underway to evaluate their usefulness in the genetic improvement of sandal.

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BANGALORE-560 003,
April 21, 1981.

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REFERENCES

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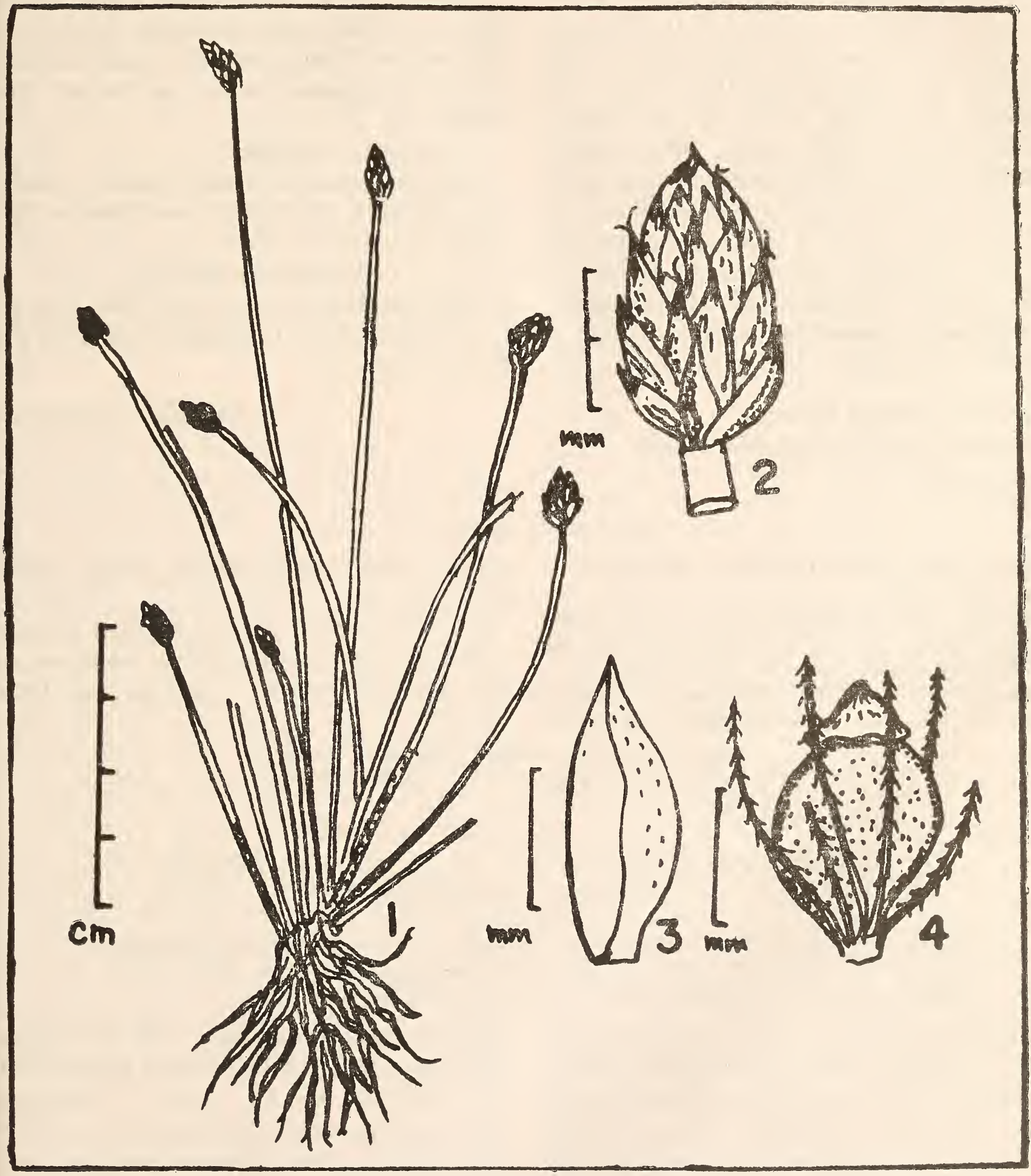
30. OCCURRENCE OF *ELEOCHARIS GENICULATA* (LINN.) ROEM. & SCHULT. (CYPERACEAE) IN UTTAR PRADESH

(*With four text-figures*)



Figs. 1-4. *Eleocharis geniculata* (Linn.) Roem. & Schult. 1. Habit; 2. Spikelet; 3. Glume; 4. Nut.

In the course of identification of the Cyperaceae collections made from Azamgarh district of Uttar Pradesh, the author identified a collection as *Eleocharis geniculata* (Linn.) Roem. & Schult. which on scrutiny of the literature has turned out as new to the state of Uttar Pradesh (cf. Duthie 1903-1929, Rau 1968, Raizada 1976, Babu 1977). *E. geniculata* is earlier recorded from Assam, Bihar, Bengal, Madhya Pradesh, Maharashtra and South India. In view of absence of any detailed illustration of the species so far, it is considered desirable to give illustration with diagnostic features of the spikelets to facilitate easy identification.

Eleocharis geniculata (Linn.) Roem. & Schult. Syst. Veg. 2: 150. 1817. *Scirpus geniculatus* Linn. Sp. Pl. 48. 1753. *E. capitata* R. Br. Prodr. 225. 1810; Clarke in Hook. f. Fl. Brit. Ind. 6:627. 1893.

Annuals, up to 40 cm high, stems tufted; spikelets broadly ovate, brownish, 4-8 x 3-3.5 mm; glumes broadly elliptic, scarcely keeled; bristles ferrugineous, as long as the nut. Nut smooth.

Fls. & Frts.: Jan.-Mar.

Specimen examined: Uttar Pradesh — Azamgarh: Ahiraula 27.11.76. *Veena Chandra* 5769 (Herb. Gorakhpur Univ.).

ACKNOWLEDGEMENTS

I am thankful to Prof. S. N. Dixit and Dr S. K. Singh of the Gorakhpur University for helpful suggestions.

BOTANICAL SURVEY OF INDIA,
CENTRAL CIRCLE, ALLAHABAD-211 002,
May 8, 1981.

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31. ON THE OCCURRENCE OF *OLEANDRA NERIIFORMIS* CAVANILLES IN INDIA

Controversy over the reported occurrence of *Oleandra neriiformis* Cavanilles is discussed in this paper and it is established that this taxon does not exist in India at all. Instead another taxon *Oleandra pistillaris* (Sw.) C. Chr. exists in India.

The taxon *Oleandra neriiformis* was described by Cavanilles (1799) from Mauben, Luzon, Philippines. Later on, most of Indian pteridogists particularly Beddome, Clarke, recently Mehra et Bir, Panigrahi, Ito considered the Indian taxon as conspecific with this taxon. Christensen (1934, 1937) raised a doubt about the occurrence of this taxon in Malaysia and he clearly established that *Oleandra pistillaris* (Sw.) C. Chr. existed in Malaysia, and caused doubts about the identity of Indian material.

During the study on the genus *Oleandra* Cav. in India this problem was taken up. Study of the original circumscription of *Oleandra neriiformis* Cav. and *Oleandra pistillaris* (Sw.) C. Chr. and the examination of authentic material housed in CAL herbarium, reveal that the Indian taxon is also *Oleandra pistillaris* (Sw.) C. Chr. which was first described from a specimen collected by Thunberg from Java by Swartz under *Aspidium.*

Detailed description of *Oleandra pistillaris* (Sw.) C. Chr. and a key to differentiate it from *Oleandra neriiformis* Cav. is. provided in this paper.

KEY TO THE TAXA

Fronds large, dimorphous, margin of old rhizome scale profusely hairy, apex of the scale acuminate, Phyllopodia 1-2 mm long, Lamina membranaceous, hairy on both surface.....*Oleandra neriiformis* Cav.

Fronds shorter, sub dimorphous, margin of old rhizome scale sparsely hairy, apex of scale acute, Phyllopodia 2-4 mm long, Lamina coriaceous, glabrous on both surface .... *Oleandra pistillaris* (Sw.) C. Chr.

Oleandra pistillaris (Sw.) C. Chr., Ind. Fil. Suppl. III: 132, 1934; Dansk. Bot. Ark. 9: 17, 1937; Holttum, Fern. Malay 2: 386, 1954; Ito in Hara's Fl. East. Himal. 3: 179, 1975.

Basinym: *Aspidium pistillare* Sw. Schrad Journ. 1800/2: 30: 1801.

Synonyms: *Oleandra neriiformis* Bedd., Fern. South India 32, 1863; Fern. Brit. India t. 264, 1868; Hand book with suppl. 285, 1892; Clarke Fern. North India 541, 1880; Panigrahi, Bull. bot. Surv. India 2 (3 & 4): 313, 1960; Mehra et Bir, Res. Bull. (n.s.) Punjab Univ. 15: 21, 1964. Ito in Hara's Fl. East Himal. 2: 208, 1971.

Epiphyte or terrestrial, rhizome stiff, cylindrical, 4-7 mm thick, erect or suberect, scandent, branched, rooting copiously, densely covered with imbricate, adpressed scales, scale peltifixed with the stem leaving a groove on the rhizome surface, dark brown, lanceolate, 4-6 mm long, 1-1.5 mm wide at basal portion, scale margin sparsely hairy, anterior part of scale gradually narrowed into acute apex. Fronds are in whorl, subdimorphous, each whorl is separated by 3-8 cm; Phyllopodia 2-4 mm long; stipe articulated to phyllopodium, 2 mm to 2 cm long, brown, dorsally grooved, rounded; Lamina simple, entire, linear-lanceolate, gradually narrowed at both ends, apex cardato-acuminate, Midrib scaly when young, raised on abaxial surface, grooved in adaxial side, Texture-coriaceous, glabrous on both surface veins free, twice or thrice forked, straight, parallel; on the margin of upper surface of lamina there are hydathodes which are arranged in a row and situated at vein endings. Sori solitary, indusiate, situated on the lateral veins forming a single row on either side of the midrib. Induisium reniform, persistent, opening away from the midrib, margin of indusium entire, Spores monolete with distinct circumvoluted perine and with echinate exine.

Specimens examined:

NEPAL: Overhanging in form of big creeper on a rock, Sundarizal, ± 1400 m, July 23, 1950, *B. D. Pande* 245 (DD-124584); Mechiriver, June 23, 1934, *s. l. s. n.* (BSI-5478).

INDIA: Assam: Mowphlong, June 17, 1956, *G. K. Deka* 2791 (ASSAM-5617); Pynkrsla, *K. Biswas* 4097 (CAL). Meghalaya: Jorrain Road, Jowai, July 24, 1957, *G. K. Deka* 10165 (ASSAM-5620); Jawain Road, ± 1450 m, Khasia & Jayantea hills, *N. P. Balakrishna* 49879 (ASSAM); Peak forest, Aug. 8, 1937, *N. L. Bor* 15481 (ASSAM-3655); Serrarin, Khasia and Jayantea hills, May 2, 1941; *D. K. Deka* 20711 (Assam-36552); Cherapunji, June 6, 1961, *H. Deka* 24537 (CAL-6035); Jayantea hills, 1000 m, Aug. 1889, *s. l. s. n.* (CAL-19839); 49 miles from Jowai, May 31, 1965, *N. P. Balakrishnan* 42298 (CAL-6406); Khasia, *Hooker et Thomson s. n.* (CAL-19841); Khasia, *s. l. s. n.* (CAL). Sikkim: Sonada, ± 1600 m, Jan. 24, 1909, *R. E. Cooper* 694 (CAL); Rinchingpong to Gassing, ± 1500 m, *T. Anderson* 1449 (CAL-19843); Sikkim, ± 2100 m, *J. D. Hooker s. n.* (CAL-19849).

West Bengal: Karseong, ± 1200, July 1974, *J. S. Gamble s. n.* (DD); Rongting, March 14, 1938, *K. Biswas* 4813 (CAL); Karseong — Way to Dow hill, Darjeeling, Oct. 3, 1974, *R. D. Dixit* 53123 (CAL-4159); Karseong, ± 1200 m, July 1874, *Gamble* 5609A (CAL). Karseong, 1200 m, July 30, 1879, *H. C. Levinge s. n.* (CAL); Kalimpong, June 1958, *S. Nakao s. n.* (CAL); Meghma *R. D. Dixit* 52993 (CAL-4848).

BHUTAN: Kamgi, ± 1200 m, Sept. 16, 1965, *G. Sengupta* 2120 (CAL).

Distribution: India — Eastern Himalayas, Nepal, Bhutan, Malaysia-Java.

South Indian locality of this taxon referred by Beddome is an error.

Oleandra neriiformis Cavanilles An. Hist. 1(2): 115, 1799.

Specimen examined: Luzon, (Type locality) Mouben, Phillippense, *Cuming* 94 (CAL) (authentic material cited by J. D. Hooker).

ACKNOWLEDGEMENTS

I am very grateful to Dr. J. N. Vohra, Regional Botanist (Cryptogams), Cryptogamic Section, Hqrs, BSI for his encouragement.

S. R. GHOSH

BOTANICAL SURVEY OF INDIA,
HOWRAH-711 103,
July 2, 1981.

32. *PALIURUS* MILL. (RHAMNACEAE) — A GENUS NEW TO INDIA

(*With three text-figures*)

While working on the taxonomy of the family Rhamnaceae in the Central National herbarium, Botanical Survey of India, Howrah, (CAL), I came across an interesting herbarium sheet, collected from Kainshli, Chamba district (Himachal Pradesh) in the N. W. Himalayan region by J. H. Lace. The plant specimen apparently looks like *Zizyphus* sp. but on careful checking can be easily identified as *Paliurus* sp. in having the following differences:

Paliurus	*Zizyphus*
1. Fruits dry, indehiscent surrounded by a circular leathery wing. (Fig. 2).	1. Fruits fleshy, wing absent (Fig. 3).
2. Seeds flattened, erect, with a little albumen.	2. Seeds plano-convex, erect, albumen almost absent.

The taxon is studied and compared with gatherings from the different regions like Western Asia, Europe and U.S.S.R., in CAL and properly identified with the help of literature and microfisches of the available type specimens.

Paliurus spina-christi Mill., a straggling shrub, is of great religious importance. It

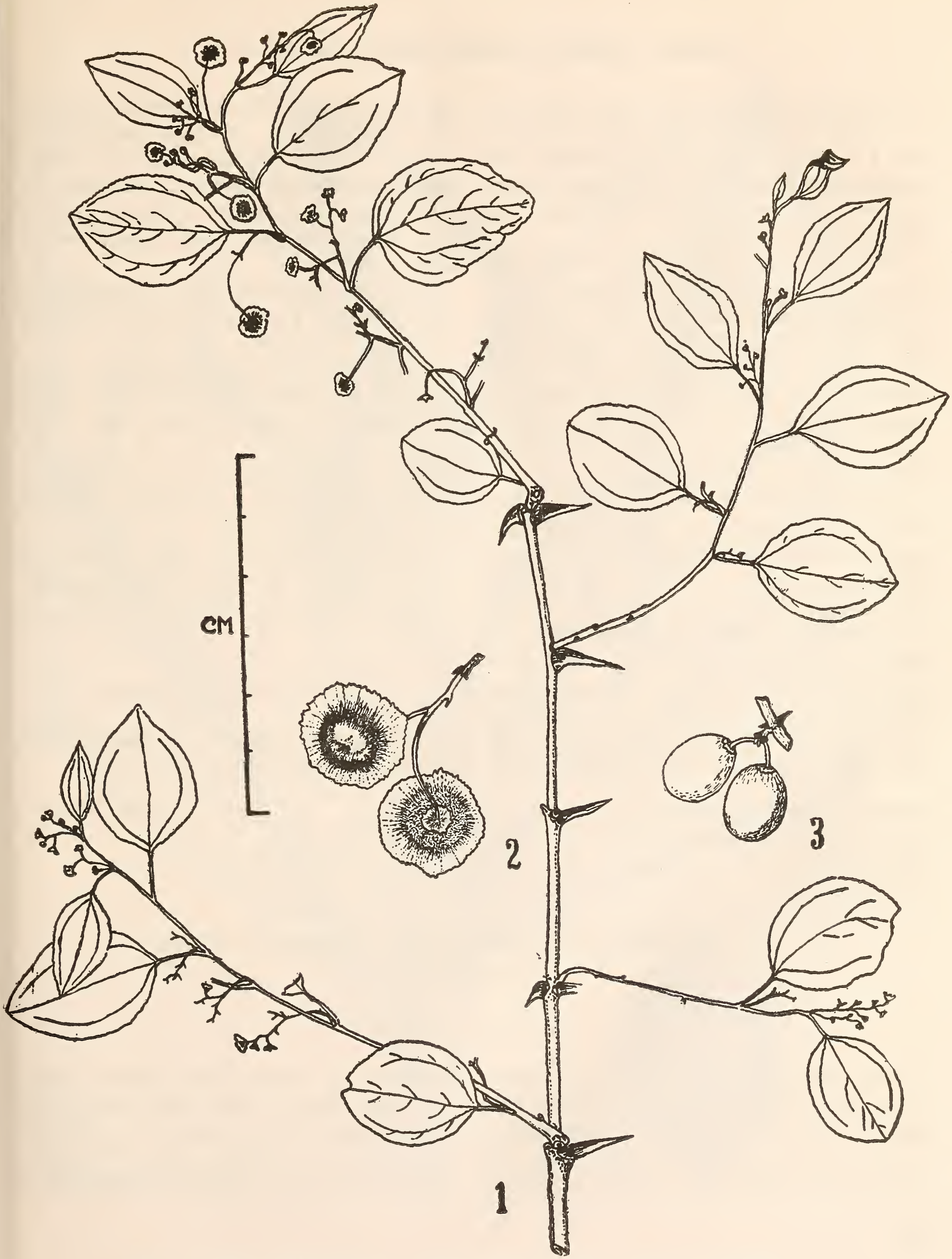

Fig. 1. *Paliurus spina-christi* — plant (in part); Fig. 2. Fruits of *Paliurus;*
Fig. 3. Fruits of *Zizyphus.*

is commonly known as the Christ's thorn as it is believed to be the plant from which the crown of thorn was made. It is generally distributed from South Europe to Japan, but was not reported from India so far and hence is of Phytogeographical interest.

The species is described below in detail with a view to facilitate its easy identification.

Paliurus spina-christi Mill. Gard. Dict. ed. viii. 1768; Post & Dinsmore, Fl. Syria, Palestine and Sinai 1:288. 1932; Hara & Williams, Enum. Fl. Pl. Nepal 2:91. 1979. *Rhamnus paliurus* L. Sp. Pl. 194. 1753. *P. aculeatus* Lamk. Tabl. Encycl. 1. t. 210. 1797; G. Don Gen. Syst. 2: 23. 1832. (Fig. 1).

Shrubs; branches round with minute pubescence on the younger parts. Spine of both types, smaller hooked, larger straight. Leaves ovate to elliptic-ovate, 2.0-3.5 x 1.3-2.5 cm, acute to obtuse, entire to minutely serrulate, usually oblique at base, prominently 3-nerved, scarcely pubescent along the nerves on both surfaces, glabrous; petioles 0.3-0.7 cm, grooved ciliate. Flowers in cymes, umbellate, few; peduncle 0.4-0.9 cm long, pedicels about 5 mm long and about 1.0 cm in fruits. Calyx 5-cleft, spreading, sepals glabrous, persistent; petals 5, convolute. Stamens 5, protruding; anthers ovate, 2-celled. Disk flat, pentagonal. Ovary 3-celled, half immersed in the disk; styles 2-3. Fruit dry, indehiscent surrounded by a circular leathery wing, 3-celled, 3-seeded. Seeds flattened with a little albumen.

Specimens Examined: INDIA: Himachal Pradesh, Chamba, Kainshli, 7000 ft., 4.6.1896, *J. H. Lace* 1404 (CAL).

PERSIA: Without any precise locality, Thanss s. n. Acc. No. 87985 (CAL—Ex Herb. Kew); Kurdistania, *O. Stapf* s. n. Acc. No. 87984 (CAL).

SYRIA: Tericho, 1863-64, *B. T. Lowne* s. n. Acc. No. 87981 (CAL); Ad Jokat, Anatobiae, *H. F. Hance* 4646 (CAL).

SWITZERLAND: Pont Du Gard, Nimes, June 1891, *J. Roberts* s. n. Acc. No. 87993 (CAL).

USSR: Tadjikistan, 24.6.1963, *Seraliev* s. n. (CAL).

ACKNOWLEDGEMENT

I am thankful to Shri G. G. Maity for his valuable suggestions.

B. SAFUI

CENTRAL NATIONAL HERBARIUM,
BOTANICAL SURVEY OF INDIA,
HOWRAH-711 103,
April 29, 1981.

33. OCCURRENCE OF *ELAEOCARPUS GRANDIFOLIUS* KURZ IN ASSAM

(*With a text-figure*)

During the course of identification of *Elaeocarpus* material collected from Arunachal Pradesh, I came across an obscurely determined specimen of *Elaeocarpus* (fruiting) deposited in Forest Research Institute Herbarium, Dehra Dun. This was collected from Jeypore Range, Lakhimpur, Assam in 1934. After critical study of the literature, the specimen was identified as *Elaeocarpus grandifolius* Kurz. The determination was later confirmed by the Central

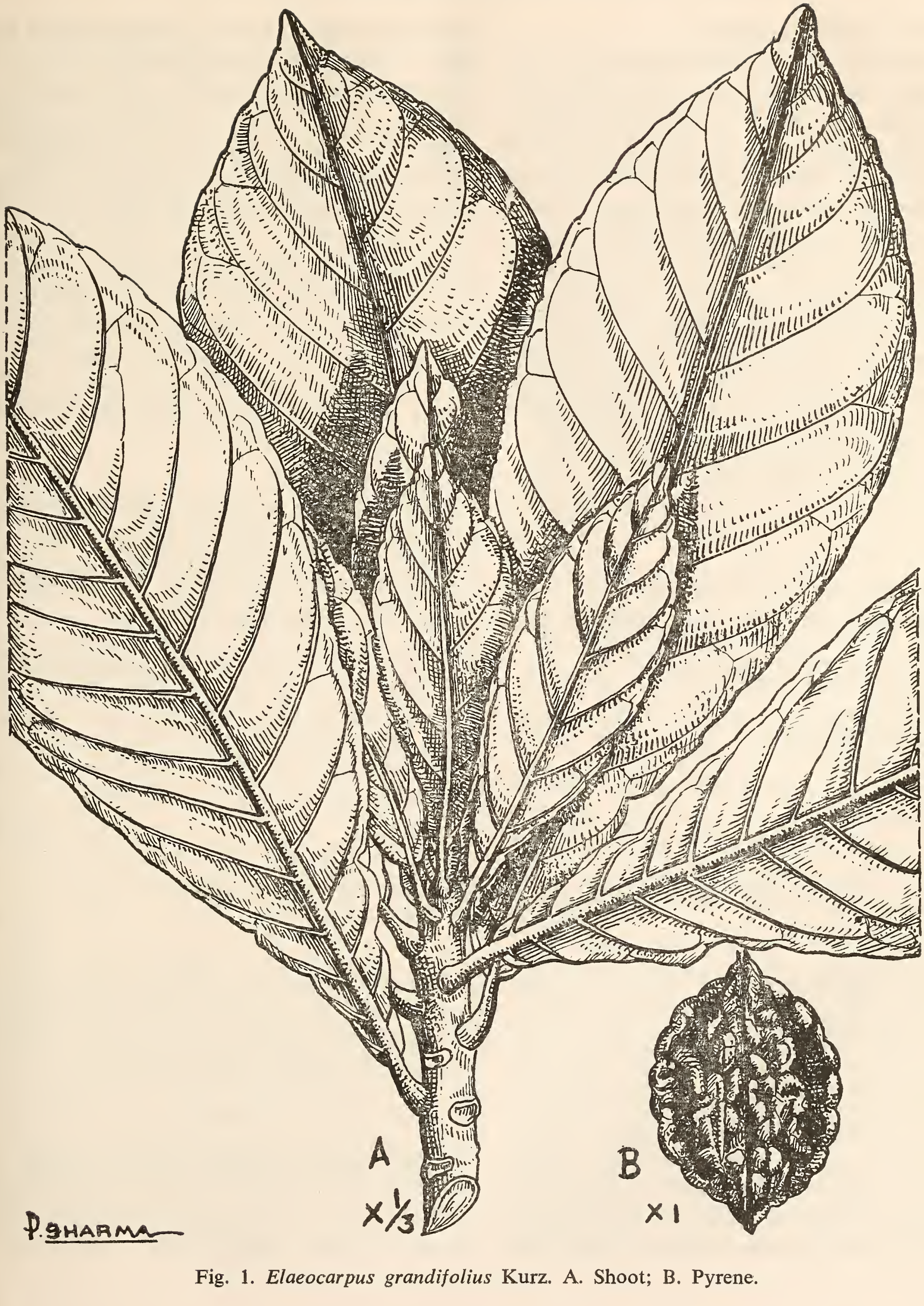
A
X 1/3
B
X 1
P. SHARMA

Fig. 1. *Elaeocarpus grandifolius* Kurz. A. Shoot; B. Pyrene.

National Herbarium, Howrah.

E. grandifolius was first described by Kurz in Journ. Asiat. Soc. Beng. 41(2): 294. 1872 from Burma. Though the species has not been mentioned by Hooker f. in Fl. Brit. Ind. 1874. Brandis in Ind. Trees. 104. 1906 indicated the possibility of Kurz's specimen belonging to *E. rugosus* Roxb., which is known from Assam. However on the basis of critical diagnosis it has been possible to establish that the two species are distinct. This paper records the occurrence of *E. grandifolius* from Lakhimpur in Assam. As the description is not provided in Hook. Fl. Brit. Ind. 1874, a detailed description along with illustration is provided.

Elaeocarpus grandifolius Kurz in Journ. Asiat. Soc. Beng. 41(2): 294. 1872 et For. Fl. Burma 1:165. 1877; Brandis Ind. Trees 104. 1906.

An evergreen tree, 9-15 m high, girth 1-1.5 m, young parts rusty tomentose; bark thin, grey, minutely postulate. *Leaves* very large 30-46 cm long *c.* 14 cm broad, obovate-oblong to obovate, minutely and remotely serrate-toothed, glabrous above, shortly puberulous beneath along the nerves, base acute or acuminate, cuneate; petiole thick, *c.* 5 cm long. *Racemes* axillary shorter than leaf; pedicels 1.5-3 cm, tomentose. *Sepals c.* 1.5 cm long, linear lanceolate, rusty tomentosa. *Petals* somewhat longer than sepals, appressed, rusty pubescent outside, 2-cleft, the lobes jagged. *Anthers c.* 8 mm long, tipped by a long arista. *Ovary* densely villous. *Drupe* oblong 3-5 cm in diam. *Pyrene* one, boney, deeply lacunose- wrinkled, somewhat compressed.

Specimen examined:

Jeypore Range, Lakhimpur (Assam), 26.6. 1934, *R.O.*, Herb. Acc. No. 66530 (DD).

Distribution: Pegu Yomah and Martaban down to Tennasserim in Burma.

FOREST RESEARCH INSTITUTE,
NEW FOREST,
DEHRA DUN-248 006,
March 31, 1981.

H. B. NAITHANI

34. NEW AND INTERESTING PLANT RECORDS FROM MAHARASHTRA

From the plant collections made during the botanical explorations in Yavatmal District, Maharashtra State, 12 plants were found to be of interest, of which 10 were new records for Maharashtra and 2 have been collected after a lapse of a considerable period-about 4 to 14 (-) decades. They are enumerated below familywise. The families have been arranged aftr Bentham & Hooker's system of classification. The herbarium specimens have been deposited in the herbarium of Western Circle, Botanical Survey of India, Pune (BSI). The collector's name for all the specimens cited will be S. Karthikeyan unless stated otherwise.

VITACEAE

Ampelocissus tomentosa (Roth) Planch. J. Vigne Am. 374. 1883. *Vitis tomentosa* Heyne ex Roth, Nov. Pl. Sp. 157. 1821; Lawson in Hook. f. Fl. Brit. India 1: 650. 1875; Cooke, Fl. Press. Bombay 1: 252. 1902.

Cooke (l.c.) reported this species from Dharwar, Belgaum and N. Kanara only. It is reported for the first time from Maharashtra.

Field notes: A shrubby climber on *Tectona grandis* L. f. Corolla pale-brown; filaments pale red, anthers yellow; ovary and style red. Fruits brown.

Specimens examined: YAVATMAL Dist.: Khandala R.F., *R. S. Rao* 90970, 1-9-1963; Durg R. F., 149293, 21-9-1978.

Fl. & Fl.: Aug.-Sept.

FABACEAE

Flemingia nana Roxb. ex W. T. Aiton, Hort. Kew. ed. 2, 4: 350. 1812; Cooke, l.c. 1: 391. 1902. *F. congesta* Roxb. var. *nana* Baker in Hook. f. l.c. 2: 229. 1876 (as to the foregoing citations, but not as described). *Maughania nana* (Roxb. ex W. T. Aiton) Mukerjee, Bull. bot. Soc. Bengal 6: 20. 1953 (*'Moghania'*).

Cooke (*l.c.*) reported this species from N. Kanara only. He also commented that it was a very rare plant in the Bombay Presidency. It is reported here for the first time from Maharashtra.

Illus.: Talbot, For. Fl. Bombay Pres. & Sind 1: 419, fig. 237. 1909 (as *F. nana*); Ic. Roxburgh. Fasc. 6: 6, Pl. 3. 1973 (as *Moghania nana*).

Field notes: Herb, *c.* 0.25 m. high, in humus soil, under shade of *Tectona grandis* L.f., on banks of dried up nalas. Inflorescence red-glandular. Calyx covered with red glands; standard petal brownish, wing petals brown with red veins, keel petals mauve. Rather rare.

Specimens examined: YAVATMAL Dist.: Morchandi Felling series, Bittergaon Range, 148538, 23-12-1976.

Fl. & Fr.: Dec.-Feb.

ASTERACEAE

Chrysanthellum indicum DC. Prodr. 5: 631. 1836; Hook f. l.c. 3: 310. 1881.

This species has not been reported by Cooke (1904) in "Flora of the Presidency of Bombay". Bedi & Thaker (1974) reported it from Gujarat. It is reported here for the first time from Maharashtra.

Field notes: Small herb, in open, humus soil, alongwith *Kyllinga tenuifolia* Steud., *Cassia pumila* Lamk., & *Alysicarpus* sp. Leaves pale beneath. Heads yellow. Rare.

Specimens examined: YAVATMAL Dist.: Penganga Felling series, Kharbi Range, 160011, 5-8-1979.

Fl. & Fr.: Aug.-Sept.

LAMIACEAE

Orthosiphon rubicundus (D. Don) Benth. in Wall., Pl. As. Rar. 2: 14. 1831; Hook. f. l.c. 4: 614. 1885; Mukerjee, Rec. bot. Surv. India 14(1): 14(1): 25. 1940. *Plectranthus rubicundus* D. Don, Prodr. Fl. Nepal. 116. 1825 (*'Plectranthes rubicunda'*).

Cooke (1906) did not report it from the erstwhile Bombay Presidency. Mukerjee (l.c.) too does not report it from this area. This is the first record for the species in Maharashtra.

Field notes: Herb, in humus soil, as undergrowth in deciduous forest, along with *Tylophora fasciculata* Ham., *Scilla hyacinthina* (Roth) MacBride and *Curcuma pseudomontana* Grah. Roots with fusiform tubers. Leaves crowded at the base. Main veins of leaves, raceme axis and sepals pale pinkish; corolla white; filaments white, anthers dark brown; style & stigma pale pink.

Specimens examined: YAVATMAL Dist.: Majra Feeling series, Patan Bori Range, 160072, 8-8-

1979; East Gondwakadi R.F., 160187, 13-8-1979.

EUPHORBIACEAE

Bridelia montana Willd. Sp. Pl. 4: 978. 1806; Hook f. l.c. 4: 269. 1887.

Cooke (1906) has not reported this species from the erstwhile Bombay Presidency. Present record of the species based on collections from Yavatmal Dist., Maharashtra is therefore an addition to Cooke's flora.

Field notes: A stunted tree from crevices of rocks on slopes. Fruits green, white speckled.

Specimen examined: Mahur R.F., on the border of Yavatmal and Nanded districts, 148532, 22-12-1976.

Fr.: Dec.

ARACEAE

Amorphophallus sylvaticus (Roxb.) Kunth, Enum. 3: 34. 1841. *Arum sylvaticum* Roxb. Fl. Ind. 3: 511. 1832. *Synantherias sylvatica* Schott, Gen. Aroid t. 28. 1858; Hook. f. l.c. 6: 518 1893; Cooke, l.c. 2: 829. 1908.

Cooke (l.c.) could not find any satisfactory evidence of this as a Bombay plant and hence he excluded it. Later, McCann (1941) collected it from Bhandup, Salsette Island, Bombay. Afterwards it has not been collected from Maharashtra. After a lapse of about 38 years, it has been located in the north-eastern part of Maharashtra, where it appears to be quite common.

Illus.: Wight, Ic. to 802. 1844.

Field notes: Herb, *c.* 0.75 m. high, in humus soil, under the shade. Stem green with white spots. Fruits green, ripening red. Common.

Specimens examined: YAVATMAL Dist.: East Gondwakadi R.F., 156523, 22-9-1978; Penganga felling series, Kharbi Range, 160019, 5-8-1979; Morchandi Felling series, Bittergaon Range, 160035, 6-8-1979; Majra Felling series, Patan Bori Range, 160075, 8-8-1979.

Fl. & Fr.: Aug.-Sept.

Theriophonum minutum (Willd.) Engl. Pflanzenr. IV, 23F: 105. fig. 15A-F. 1920.

Arum minutum Willd. Sp. Pl. 4: 484. 1805; Graham, Cat. Bombay Pl. 228. 1839.

Cooke (1908) did not report this species from erstwhile Bombay Presidency, though Graham (l.c.) listed it from S. Concan based on the authority of Nimmo. Since then, no collections have been made for the past 14 decades from Maharashtra including Concan. Presently, it is being reported from Yavatmal where it is quite abundant.

Field notes: Tuberous herb, under shade of teak plantations in humus soil, alongwith *Neanotis lancifolia* (Hook. f.) W. H. Lewis, *Justicia diffusa* Willd., *Sporobolus diander* (Retz.) P. Beauv. and *Curcuma pseudomontana* Grah. Spathe green. Female flowers at the base in a single row, green, stigma white; neuter florets above the female, dark brown; male flowers above the neuters, reddish-brown; above male flowers neuter florets present; appendage brown. Berries green.

Specimens examined: YAVATMAL Dist.: Durg R.F., 149300, 9-9-1978; Morchandi Felling Series, Bittergaon Range, 160039, 6-8-1979; Hiwri R.F., 160170, 8-8-1979.

Fl. & Fr.: Aug.-Sept.

CYPERACEAE

Fimbristylis sieberiana Kunth, Enum. 2: 237. 1837; Kern in van Steenis, Fl. Males. ser. 1, 7(3): 572. 1974; Shah & Suryanarayana, J. Bombay nat. Hist. Soc. 66: 414. 1969.

Cooke (1908) has not reported this species from former Bombay Presidency. It has been reported by Shah & Suryanarayana (l.c.) from Gujarat. This is reported here for the first time from Maharashtra.

Field notes: Herb, *c.* 0.75 m high in marshy soil, on banks of nalas. Glumes rusty-brown; anthers cream or brown; styles green with brownish tinge. Abundant.

Specimens examined: YAVATMAL Dist.: Wani-Mukutban road, 148420, 14-12-1976; Durg camp, 156506, 21-9-1978.

Fl. & Fr.: Sept.-Dec.

Schoenoplectus litoralis (Schrad.) Palla, Verh. K. K. Zool. — Bot. Ges. Wien 38, Sitzb.: 49. 1888 (*'littoralis'*). *Scirpus litoralis* Schrad. Fl. Germ. 1: 142, t. 5, fig. 7. 1806; Clarke in Hook. f. l.c. 6: 659. 1893; Cooke, l.c. 2: 894. 1908; Kern, l.c. 510.

Cooke (l.c.) reported this species from Sind and Gujarat only. Presently this has been collected in Maharashtra and hence reported here.

Illus.: Mahesh. Illus. Fl. Delhi fig. 227. 1966.

Field notes: Herb, *c.* 2 m high, in marshy soil, on the banks of river. Culm cylindrical. Glumes brownish-red with scarious margins; filaments white, anthers yellow; styles white. Abundant.

Specimens examined: YAVATMAL Dist.: Penganga river, Kharbi, 149044, 13-2-1977.

Fl. & Fr.: Jan.-March.

Scleria parvula Steud. Syn. 2: 174. 1885; Napper in Hepper, Fl. W. Trop. Afr. ed. 2, 3 (pt. 2): 343. 1972; Kern, l.c. 746.

S. tessellata (non Willd.) Boeck, Linnaea 38: 470. 1874, *p.p.;* Clarke in Hook. f. l.c. 6: 686. 1894, *p.p.*; Cooke l.c. 2: 903. 1908, *p.p.*

S. tessellata sensu Clarke (l.c.) from India is a mixture of three species viz. *S. mikawana* Makino, *S. parvula* Steud. and *S. tessellata* Willd. So far, *S. parvula* Steud. has not been reported from Maharashtra and is reported here for the first time.

A key to differentiate *S. tessellata* Willd. from *S. parvula* Steud. is given below:

Lateral panicles erect; peduncles rigid, usually short; achene cylindric to ellipsoid-cylindric, 1.5-2 mm diam., glabrous, obscurely or distinctly striate-lacunose, the lacunae vertically elongated. *S. tessellata*

Lateral panicles pendulous; peduncles long and flexuous; achene obovoid-globose to oblong-ellipsoid, 1.5-2.2 mm diam., deeply and squarely lacunose, usually hairy on the walls *S. parvula*

Field notes: Herb, *c.* 0.75 m high, in marshy soil, on edges of streams. Blades sharp. Glumes green. Nuts green, ripening white. Common.

Specimens examined: YAVATMAL Dist.: Jodhmoha grass farm, 156532, 22-9-1978; Pandharkawda-Bhiwkund road, 3 km. point, 156581, 24-9-1978.

Fl. & Fr.: Aug.-Sept.

POACEAE

Brachiaria remota (Retz.) Haines, Bot. Bihar & Orissa 1005. 1924; Bor, Grass. India, Burma & Ceylon 285. 1960. *Panicum remotum* Retz. Obs. Bot. 4: 17. 1786; Hook. f. *l.c.* 7: 38. 1896.

So far, this species has been found to occur only in Orissa and Tamil Nadu (Bor *l.c.*). Hence it is an addition to the Flora of Maharashtra.

Field notes: Herb, in humus soil, as forest undergrowth. Glumes green.

Specimens examined: YAVATMAL Dist.: Majra felling series, Patan Bori Range, 160079 8-8-1979.

Fl. & Fr.: Aug.-Nov.

Themeda laxa (Anderss.) A. Camus in Bull. Mus. Hist. Nat. Paris 26: 423. 1920; Bor, Grass. India, Burma & Ceylon 251. 1960. *Anthistiria laxa* Anderss. in Nov. Act. Sci. Upsal. ser. 3, 2: 243. 1856; Hook. f. *l.c.* 7: 1896.

This species has been previously recorded from Madhya Pradesh (Bor, *l.c.*) only. This is an additional species for the flora of Maharashtra.

Field notes: Herb, *c.* 1.75 m high, in cultivated fields, in open situations. Spikelets green.

Specimens examined: YAVATMAL Dist.: Yavatmal-Yelabara road, 156529, 22-9-1978.

Fl. & Fr.: Aug.-Oct.

BOTANICAL SURVEY OF INDIA,
WESTERN CIRCLE,
PUNE 411 001,
January 21, 1981.

ACKNOWLEDGEMENTS

We are thankful to the Director, Botanical Survey of India for facilities and to Dr. B. D. Sharma, Deputy Director, Botanical Survey of India, Western Circle, Poona for encouragement.

S. KARTHIKEYAN
ANAND KUMAR

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35. NOTES ON *VIOLA PILOSA* BL. (VIOLACEAE)

The plant, commonly known as *V. serpens* Wall. in the Indian Floras is *V. pilosa* Bl. Although Hook. f. et Thoms. in Fl. Brit. Ind. (1872) quoted *V. pilosa* Bl. Bijr. (1825) in the synonymy of *V. serpens* Wall. (1824), the diagnostic characters of *V. pilosa* were first published by Blume in his Cat. Grew. Buitenz. (1823). So the valid name of *V. serpens* Wall. ex Ging. is *V. pilosa* Bl.

V. pilosa is a very variable species and is common throughout the hilly regions of India. Larger forms grow in shady humid places and smaller forms in rock-crevices. *V. serpens* ssp. *serpens* var. *deltoidea* W. Beck. (TYPE: Shillong, *C. B. Clarke* 43494 in CAL!) and *V. serpens* ssp. *garhwalensis* W. Beck. (TYPE: Tihri-Gurhwal, *Duthie* 1178, CAL-lecto!) are considered here synonymous with *V. pilosa* being smaller forms of the same species. The synonyms and citations of this species are given below:

V. pilosa Bl. Cat. Grew. Buitenz. 57. 1823 et in Bijdr. 57. 1825; Jacobs et D.M. Moore in Fl. Males. 7: 207. 1971, [—excl. syn. *V. glaucescens* Oud.]; Hara in Bull Univ. Mus. Univ. Tokyo 8:83. 1975—Type: Java, *Blume* s.n. L-holo, Photo. *V. serpens* Wall. ex Ging. in DC. Prodr. 1: 296. 1824; Royle, Ill. Bot. Himal 74. t. 18. f 1. 1834; Hook. f. et Thoms., Fl. Brit. Ind. 1: 184. 1872. *V. serpens* ssp. *garhwalensis* W. Beck. in Beih. Bot. Centralbl. Abt. 2., 34: 255. 1916, syn. nov. *V. serpens* ssp. *serpens* var. *deltoidea* W. Beck. *l.c.* 40: 105. 1923, syn. nov. *Fls.*: March to May; *Frts.*: May to July, often extending throughout the year.

Distribution: Throughout India; Afghanistan, Pakistan, Sri Lanka, Nepal, Bhutan, Bangladesh, Burma, China, Indo-China (Thailand), Malaysia to Malesian Islands (Java).

Central National Herbarium,
Botanical Survey of India,
Howrah-711 103,
June 19, 1981.

S. P. BANERJEE
B. B. PRAMANIK

36. SOME NOTEWORTHY PLANTS FROM KOLABA DISTRICT (MAHARASHTRA STATE)

During floristic studies of Kolaba district (Maharashtra State) 5 plants namely *Ficus callosa* Willd. (Moraceae), *Flemingia gracilis* (Mukherjee) Ali (Fabaceae), *Gymnema khandalense* Sant. (Asclepiadaceae), *Hygrorhiza aristata* (Retz.) Nees ex W. & A. (Poaceae) & *Oldenlandia biflora* L. (Rubiaceae) are found to be noteworthy and hence it was thought desirable to put these plants in record as it will help in their location. All the specimens cited are deposited in the herbarium of the Botanical Survey of India, Western Circle, Pune (*BSI*) under the senior author's name.

Ficus callosa Willd. Mem. Acad. Roy. Sci. Hist. (Berlin) 102. 1798; Gamble, Fl. Pres. Madras 8: 1364. 1928. '*Ghurud*— Marathi'.

Cooke (1901-1908) has not reported this species while Gamble (l.c.) states that it is not uncommon in W. Ghats. A solitary tree was observed in the district, which, however, was marked for cutting by the Maharashtra State Forest Department. Hence the present record from Kolaba district becomes the northernmost limit of its occurrence in Western Ghats.

A huge tree with giant buttressed roots.

Fl. & Fr.: February-March.

Locality: Masadi Forest (Roha) 156470.

Flemingia gracilis (Mukherjee) Ali in Biologia 12: 78. 1966. *Moghania gracilis* Mukherjee in Bull. bot. Soc. Bengal 6(1): 22-24. 1953; Reddi in Bull. bot. Surv. India 11: 145. 1969.

Mukerjee (l.c.) described this species from Khandala in Pune district based on Santapau's collections. Thereafter it was collected by Reddi (l.c.) from the same district and therefore its present record from the adjoining Kolaba district is very interesting and worth putting on record.

An extremely rare plant in Kolaba district as it was observed only in one locality that too on a steep cut slope of the rock.

Fl. & Fr.: September-October.

Locality: Porcupine point, Matheran 147387.

Gymnema khandalanse Sant. in Kew Bull. 1948. 486. January 1949 et Rec. bot. Surv. India 16(1): 52. ed. 3. 1967.

It is described as a new species from Khandala by Santapau (l.c.) and nobody has reported it thereafter. Hence its present record from Kolaba district is the second report of its occurrence and thus establishes itself as a good species confined to a limited area. However, because of biotic interference in that particular locality its very existence is threatened and thus it is very much endangered.

A climber with straight or slightly curved follicles. This plant was collected only once and that too in fruit. However, flowering specimens collected by Santapau are represented in Blatter Herbarium, Bombay.

Fr.: March 1979.

Locality: Masadi Forest, Roha 156472.

Hygrorhiza aristata (Retz.) Nees ex W. & A. in Edinb. New Phil. J. 15: 380. 1833; Cooke in Fl. Pres. Bombay 2: 1041. 1908. *Pharus aristata* Retz. Obs. 5: 23. 1789.

Cooke (l.c.) has recorded this plant from Chikli (Gujarat) only and Gamble (1915-36) records from both the coasts down south. The present report from the Kolaba district in Maharashtra State thus bridges the gap in its distribution.

An attractive aquatic grass with purplish, handsome swollen leaf-sheaths and greenish-yellow spikelets; worth introducing in gardens in shallow ponds.

Fl. & Fr.: December-March.

Locality: Gavalwadi pond, Karjat 154503.

Oldenlandia biflora L. Sp. Pl. 119. 1753; Hooker in Fl. Brit. India 3: 70. 1897.

Cooke (1901-08) has not recorded this species from Maharashtra State. Gamble (l.c.) also notes its infrequent occurrence on the W. coast and it was also represented from Lakshadweep (Laccadives) in BSI. Therefore, its present record from Maharashtra State is the first one from the State.

A branched succulent herb with white flowers. A rare plant growing on moist-moss covered rocks near sea-shores.

Fl. & Fr.: September-October.

Locality: Murud 147855.

Botanical Survey of India,
Western Circle, Pune,
May 7, 1981.

M. J. KOTHARI
SIRASALA MOORTHY

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Gamble, J. S. & Fischer, G. E. C. (1915-36): Flora of the Presidency of Madras. Parts 1-11. London.

37. THE GENUS *DESCHAMPSIA* IN N. W. HIMALAYA

Deschampsia belongs to the tribe Aveneae of Poaceae. It has about 60 species distributed mostly in temperate regions. In India the genus is represented by two species *D. caespitosa* and *D. koelerioides.* Both occur in the North Western Himalayan region at an altitude of about 4000 m. The plants have golden brown or purplish green shining spikelets and may prove worthy of introduction in alpine gardens. A third species *D. flexuosa* occurs in Nepal and may be expected in India. [Santapau & Henry (Dictionary 53, 1973) while dealing with the genus mention the occurrence of three species in India].

Type species — *Deschampsia caespitosa* (L.) P. Beauv. = *Aira caespitosa* L.

Deschampsia P. Beauv., Ess. Agrost. 91. t. 18.f.3.1812; Hook. f. Fl. Brit. Ind. 7: 273. 1897; Bor Grasses Burm. Cey. Ind. & Pak. 435. 1960.

Perennials. *Culms* ascending, glabrous; sheaths glabrous, striate. *Leaves* mostly basal, glabrous, acute; ligule membranous. *Inflorescence* contracted or spreading panicle, shining. *Spikelets* usually 2-flowered; rhachilla produced, pilose, breaking up above the glumes. *Glumes* hyaline, equal or sub-equal, longer than the lemmas. *Lemmas* broad, toothed or lobed, awned on the back; callus hairy. *Paleas* shorter than the lemma, 4-toothed, Anthers 3. Styles 2. Lodicules 2.

KEY TO SPECIES

1. Inflorescence much spreading .....*D. caespitosa*
1a. Inflorescence contracted ....*D. koelerioides*

D. caespitosa (L.) P. Beauv., Ess. Agrost. 91. 160. 1812; Hook. f. Fl. Brit. Ind. 7: 273. 1897; Bor, Grass. Burma, Cey., Ind. & Pak. 435. 1960; Stewart, Fl. West Pakistan 136. 1972; Kachroo *et al.* Fl. Ladakh 157. 1977.

Perennial grasses. *Culms* glabrous, curved at the base; sheaths scarious margined. *Leaves* linear ± 25 cm x 2.5 mm wide; ligule ± 4 mm long, toothed, *Inflorescence* a spreading panicle, shining purplish; rachis distantly scabrid. *Spikelets* pedicelled, usually 2-flowered; rachilla produced, pilose. *Lower glume* ± 4 mm long, ovate-elliptic. *Upper glume* ± 5 mm long, boat-shaped, broader than the lower glume. *Lemma* ± 3.5 mm long, broad, toothed or 4-lobed awned; awn basal to median, nearly equalling the lemma, hardly visible beyond the glumes. *Palea* shorter than the lemma- 4-toothed. Anthers 3, ± 2 mm. long. *Ovary* brownish.

Ecological note:

Fairly common, on moist, sandy stream beds mainly in drier W. Himalayan region, 2800-4400 m.

Specimens examined: Himachal Pradesh — Kinnaur; Between Chitral & Ranikanda, 3400 m., 29.9.1964, N.C. Nair 34393. (BSD), Kulu: Manali 2800 m, 2.8.1941, Kirat Ram 15586 (DD). Lahul & Spiti: Rohtang Pass, 3950 m., N. L. Bor 11939 (DD); Thumla, 4200 m. 1.8.1972, U. C. Bhattacharyya 49210 (BSD). Jammu & Kashmir-Ladakh: Chushul, 4329 m. 26.7.1931, W. Koelz 2447b (DD.) Uttar Pradesh-Kumaon: Ralam Valley, 3800 m. 23.8.1884. J. F. Duthie 3549 (DD), 3550 (CAL); Tehri: Kharga Ka gadh, 3950 m. 8.8.1883, J. F. Duthie 268 (DD); Uttarkashi: Nila Valley 3900 m. 16.8.1883, J. F. Duthie 290 (CAL).

D. koelerioides Regel in Bull. Soc. Nat. Mosc. 41: 299. 1868; Hook. f. Fl. Brit. Ind. 7: 273. 1897; Bor Grasses Burm., Cey., Ind. & Pak. 435. 1960; Stewart, Fl. West Pakistan 136. 1972; Kachroo *et al.* Fl. Ladakh. 157. 1977

Rhizomatous. *Culms* glabrous. *Leaves* ± 6 mm x 3 mm., glabrous, acute; ligule ± 3 mm. long. *Inflorescence* contracted, shining purplish green; rachis distantly scabrous. *Spikelets* pedicelled, usually 2-flowered; rachilla produced, long hairy. *Lower glume* ± 3 mm. long, lanceolate, acute. *Upper glume* ± 4 mm. long, ovate-elliptic, acute. *Lemma* ± 3 mm long, oblong, toothed or lobed, awned; awn basal to median, not or slightly visible beyond the glumes. *Palea* shorter than the lemma, 4-lobed, *Anthers* 3, ± 1.2 mm long.

Except in the compact nature of the inflorescence, this species cannot be distinguished from *D. caespitosa.* Population study of both the species may prove these to be variant forms of one species. Since locating this species is a matter of chance, very intensive field observation and biosystematic study are necessary to establish specific identity of *D. koelerioides.*

Ecological note:

On wet sand around boulders. Rare. Though it has been stated to be common, the representation of this species from the Indian region is very poor in DD herbarium and at CAL.

Specimens examined: Jammu & Kashmir-Ladakh: Gomburangzang, Kargiakh Cho, 4500 m, 24.7.1973, U. C. Bhattacharyya 52200 (BSD, CAL).

BOTANICAL SURVEY OF INDIA,
NORTHERN CIRCLE,
DEHRA DUN,
May 26, 1981.

B. P. UNIYAL[1]
U. C. BHATTACHARYYA

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[1] Central National Herbarium, Botanical Survey of India, Howrah.

38. ADDITIONS TO THE GRASSES OF BIHAR, ORISSA & WEST BENGAL

Jain *et al.* (1975) published a list of grasses of Bihar, Orissa and West Bengal. They did not include some of the known species because of the non availability of representative specimens. We have identified few such specimens that can now be added to the list. The specimens studied are mentioned below.

1. *Calamagrostis pseudophragmites* (Hall. f.) Koeler var. *pseudophragmites.*
   W. BENGAL: Darjeeling, 1800-2100 m., Aug., 1957, K. C. Chowdhury 1 (CAL).
2. *Dichanthium pallidum* (Hook. f.) Stapf ex Fisch.
   ORISSA: Gunjam, Dec. 1949, W. Wight 3023 (CAL).
3. *Festuca gigantea* (L.) Vill.
   W. BENGAL: Darjeeling, Tiger hill, 2400 m., 6.7.1956, D. Chatterjee's collector 77 (CAL).
4. *F. undata* Stapf var. *aristata* Stapf
   W. BENGAL: Darjeeling, 3500 m., 27.6.1960, A. B. Chowdhury 31 (CAL).
5. *Paspalum longifolium* Roxb.
   W. BENGAL: Malda, Sarul forest, 25.8.1966, R. M. Dutta 489 (CAL).

ACKNOWLEDGEMENT

We are grateful to the Deputy Director, Central National Herbarium for encouragement.

BOTANICAL SURVEY OF INDIA,
CENTRAL NATIONAL HERBARIUM,
HOWRAH-711 103,
August 12, 1981.

B. P. UNIYAL
(MRS.) R. DUTTA

REFERENCE

JAIN, S. K., BANERJEE, D. K. & PAL, D. C. (1975): Grasses of Bihar, Orissa & West Bengal. *J. Bombay nat. Hist. Soc.* 72(3): 758-773.

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39. A LITTLE KNOWN FERN FROM THE HIMALAYA — *ASPLENIUM NESII* CHRIST, AND THE NOMENCLATURE OF *A. EXIGUUM* BEDD. (ASPLENIACEAE)

(*With a text-figure*)

A description of the little known, *Asplenium nesii* Christ, hitherto unrecorded in the Himalayan fern literature is provided. Its further detection in the various herbaria (under *A. varians* or *A. exiguum*) or from other localities in the Himalaya would help in determining the geographical range of this Chinese fern. The real *A. exiguum* Bedd. occurs in south India only. The Himalayan fern conventionally so known is much different and should be given another name.

An *Asplenium* collected from Deoban (2,700 m) above Chakrata, Mussoorie hills (W. Himalayas) was found to be distinct from all known Himalayan species of this genus. Prof. T.

Reichstein (Basel, Switzerland) confirmed the identity of this fern as *Asplenium nesii* Christ. It is unrecorded in Himalayan fern literature and a detailed description of this species is very much required and desirable as it seems to be not much known to Indian pteridologists.

Asplenium nesii Christ

Rhizome short, erect to ascending, apex clothed in black clatherate ovate-lanceolate 2.5-3.0 mm long scales; fronds numerous, 2-12 (14) cm long x 1-2 (3) cm broad (at the widest), grey-green; stipe short 2-6 cm, 2-10 times shorter than the lamina, invariably black, at least in the lower half, green upwards, a tuft of scales (similar to those on rhizome apex) at base, less dense becoming scattered narrower hair-like and light-brown upwards running on to half of rachis, 0.5-1 mm thick; lamina coriaceous to subcoriaceous, lanceolate widest a little above the middle, tapering to base, tip incised on both sides to produce 3-5 blunt teeth on each side directed upwards, bipinnatifid or partly bipinnate in the lower part; pinnae 8-12 pairs, 0.5-1.5 cm long, more or less linear, bases cuneform, lower ones shortly stipitate stalk 0.5-1 mm, upper ones becoming decurrent and sessile, lower pair of pinnae small, often irregular, about 1 cm apart from the next pair, becoming slightly closer higher up and sometimes touching the next but not crowded, larger pinnae (0.5) 0.8-12 (15) cm long x 0.3-0.5 cm broad, deeply incised to form 2-4 irregular lobes on both sides, the larger lobes often forked or cleft again forming obtuse teeth that are directed towards the midrib; rhachis green, lower portion scaly; veins obscure; indusia whitish, entire, open up at maturity; sori close to the costae, 5-7 (10) to a pinna; spores bilateral, brown, perinate, perine large, (30) 34-42 (45) μm long.

(Based on Ching and Reichstein (1980); emended on basis of present specimens personally examined).

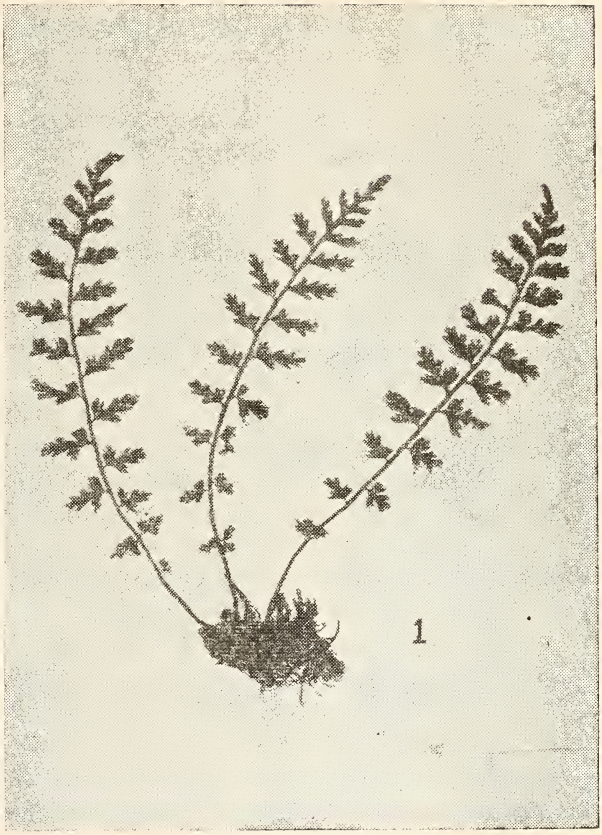


Fig. 1. *Asplenium nesii* Christ from Deoban 2700 m, Chakrata hills.

Characteristic features: A small fragile fern growing in the clefts and fissures of dry but shaded rocks. Stipes many, tufted, blackish at least in the lower portion, higher up and rhachis green; lamina bipinnatifid, grey-green, coriaceous to subcoriaceous, widest a little above the middle, lower pinnae small and distinct. Fig. 1.

Extremely rare in the Deoban forest (2,700 m), Uttar Pradesh. Specimens have been deposited at PAN (Chandigarh) and PUN (Patiala).

A. nesii has been detected from previous collections from only the following three Himalayan localities:—

(i) Uttar Pradesh, Kumaon; rocks in Dhauli Valley, 3,000 m, J. F. Duthie, 6.8.1886 (DD).

(ii) Uttar Pradesh, Deoban, 2,700 m; R. L. Flemming, 1.10.1951 (MICH) No. 1096.

(iii) Himachal Pradesh, Lahul, Shipting Nulla, 3,300 m; Walter Koelz, 2.8.1938 (MICH) — doubtful.

The above three herbarium specimens were identified provisionally as *A. nesii*, by Ching and Reichstein (*pers. comm.*) although no. (i) had been labelled as *A. exiguum* and no. (ii) as *A. varians*. (Herbaria: DD = herbarium of the F.R.I. Dehradun; MICH = The University of Michigan, U.S.A.).

The present gatherings of *A. nesii* are the first authentic record for this fern from the Himalaya. It is quite probable and possible that a re-examination of the specimens in various herbaria all over the country, under *A. varians* Wall. *ex* Hook. & Grev. *A. exiguum* Bedd. and *A. pseudofontanum* Koss., Naturl. System. Herb. Hortii Petr. *3*: 121-124 (1922) (earlier known as *A. fontarum* (L.) Bernh. in which the lamina is more divided and pinnae more numerous), may be successful in detecting and adding to the number of Himalayan localities for this primarily Chinese fern. The geographical range of *A. nesii* could also thus be determined.

A. nesii shares with *A. varians* the absence of proliferating buds on lamina. But in *A. varians* the lamina is herbaceous, primarily bipinnate (1-pinnate or tripinnatifid), bright-green (not grey-green); lowest pinnae generally only a shade smaller (or even longer) than the second pair which is often the largest and only the extreme basal 1-2 cm of stipe may be black.

Another Himalayan fern quite close to *A. nesii* is *A. exiguum*. Both have a similar frond form (tapering at ends and broadest a little above middle) and blackish stipes. *A. exiguum*, however, differs in having: complete and even lower part of rhachis blackish, vegetative proliferating buds always present, lamina herbaceous, bright-green; prefers more humid situations compared to *A. nesii*.

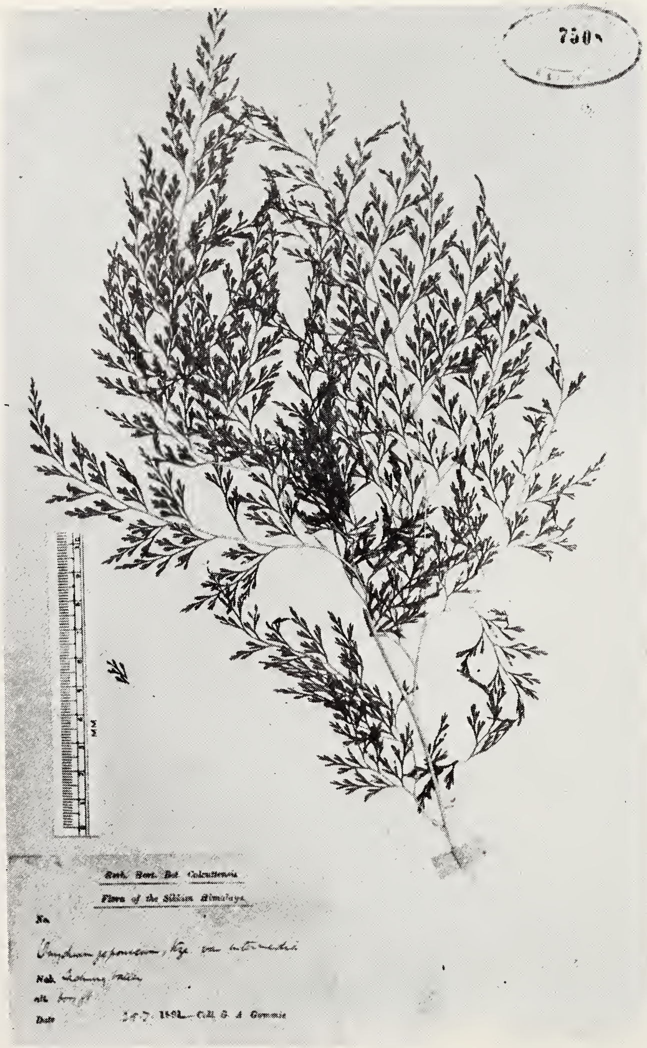
NOMENCLATURE OF *A. exiguum*

It would be pertinent to point out here that true *A. exiguum* Bedd. occurs only in south India. The form described from various localities in the Himalaya (Mehra, 1939, from Mussoorie; Bir, 1962 from Simla; Verma & Khullar, 1980 from Nainital; Dhir, 1980 from N. W. Himalaya, etc.) under this name is different. Earlier, Hope (1901) had pointed out the distinctness of the Himalayan and south Indian forms, but later workers unfortunately treated these under a common name.

In the south Indian taxon, vegetative buds are present only on an extended rhachis and not on pinnae; many fronds of a plant are with such buds. The Himalayan form has vegetative buds on both, an extended rhachis (only on a few fronds of a plant) and pinnae. Another fern of this group, *A. yunnanense* Franchet, also has vegetative buds on the apex, but the rhachis is not extended (Reichstein, *pers. comm.*). The Himalayan form is thus distinct from the true south Indian, *A. exiguum*.

ACKNOWLEDGEMENTS

We owe a great debt of gratitude to Prof. T. Reichstein (Basel, Switzerland) for identifications, and for providing some very important literature and useful suggestions without which it may not have been possible to redis-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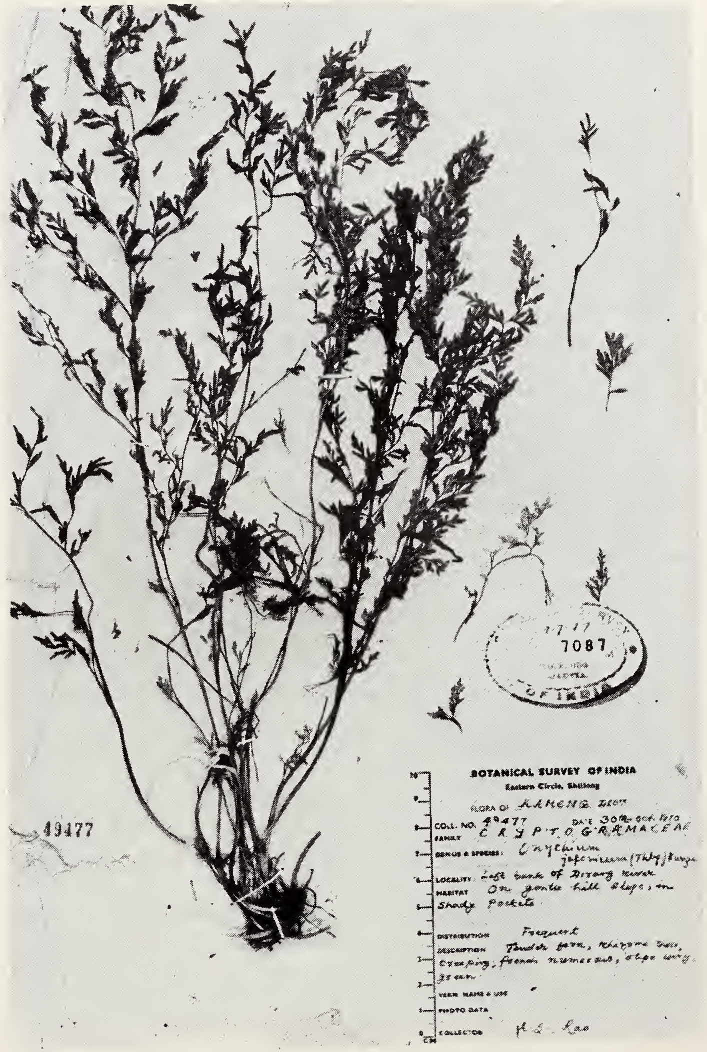
MM
Herb. Hort. Bot. Calcuttensis
Flora of the Sikkim Himalaya
No.
Nat.
alt.
Date
Coll. G. A. Gammie

Onychium plumosum Ching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49477
BOTANICAL SURVEY OF INDIA
Eastern Circle, Shillong
FLORA OF KAMENG DIST
COLL. NO. 49477
DATE
FAMILY CRYPTOGRAMMACEAE
GENUS & SPECIES Onychium
LOCALITY
HABITAT
DISTRIBUTION Frequent
DESCRIPTION
VERN. NAME & USE
PHOTO DATA
COLLECTOR
CM

Onychium tenuifrons Ching

cover this fern. We would also like to record our thanks to Profs. S. C. Verma (Punjab, Chandigarh) and S. S. Bir (Punjabi, Patiala) for their encouragement.

BOTANY DEPARTMENT,
PUNJAB UNIVERSITY,
CHANDIGARH-160 014,
April 30, 1981.

S. P. KHULLAR
SHANTI S. SHARMA
PARAMJIT SINGH

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40. *ONYCHIUM PLUMOSUM* CHING, *O. TENUIFRONS* CHING — TWO NEW RECORDS OF FERN FOR INDIA

(*With a plate and four text-figures*)

During the scrutiny and examination of *Onychium* specimens housed in (CAL) the herbarium of Botanical Survey of India, Howrah, we came across a few specimens collected by *Gammie* and *Rao* from Lachen valley, Sikkim; and Kameng, Arunachal Pradesh which after careful study turned out to be *Onychium plumosum* Ching and *O. tenuifrons* Ching. These two taxa were previously described and reported from Yunnan, China by Ching. Our study shows that these two taxa occur also in India. *O. plumosum* is closely allied to *O. contiguum.* A key to distinguish it from *O. contiguum* and detailed description of the two taxa based on Indian material is provided in this paper. The genus *Onychium* is represented in India by five species and one variety.

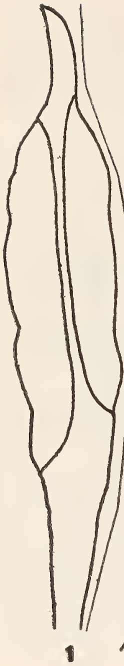
KEY TO THE TAXA

Frond compact, lamina 20-35 x 11-25 cm, sterile pinnae finely dissected, ultimate segment small, colour pale when dry, mature sori thick, 2-5 mm long.... .... *O. contiguum*

Frond lax, lamina 50-60 x 20-30 cm, sterile pinnae coarsely dissected, ultimate segments large, colour green when dry, mature sori thin, 3-6 mm long.... .... *O. plumosum*

Onychium plumosum Ching, Lingnan Sci. Jour. 13(3): 499. 1934. *Onychium japonicum* var. *parvisorum* R. Bona parte, Notes Pterid. 14. 1923; Kummerle, Amer. Fern. Jour. 20: 137. 1930.

Lamina large 50-60 x 20-30 cm, 4 pinnate, primary pinnae petiolate, alternate, 5-10 cm apart, 8-12 pairs, basal pair largest 22-26 x 8-10 cm, secondary pinnae petiolate 8-12 x 4-6



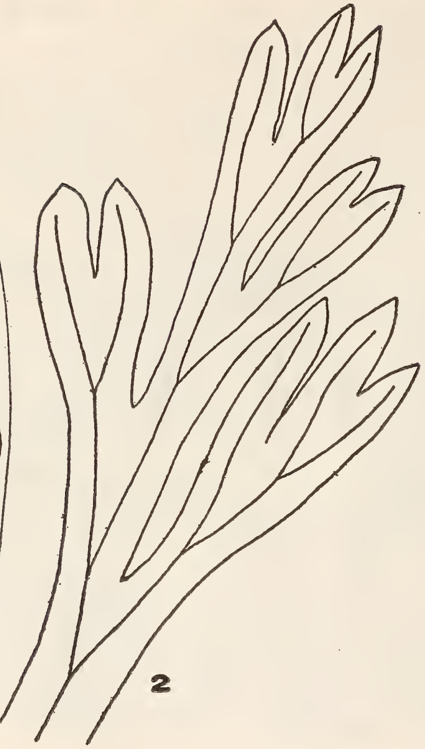


Fig. 1. Sorus of *O. plumosum* Ching with indusium.
Fig. 2. A pinnule of *O. plumosum* Ching.

cm, 8-9 jugate, tertiary pinnae again pinnatifid, ultimate segment about 8 mm long; texture thin, colour green when dry; vein not very distinct, one in each lobe, Sori 3-6 mm long, thin; Indusium whitish to grey, membranaceous, entire.

Specimens examined:

SIKKIM — Lachen valley; 1880 m, 29.7.1892, *G. A. Gammie s. n.* (7508, 7509 — CAL). Falc. 1262A; 1262B (CAL).

Earlier record: China.

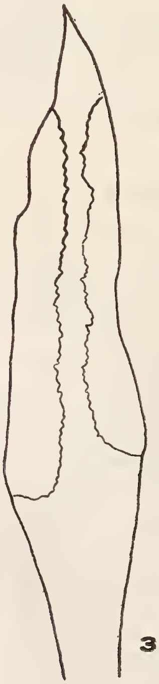
Onychium tenuifrons Ching, Lingnan Sci. Jour. 13(3): 500. 1934; Icones Filicum Sinicarum Fasc. 4. Pl. 163. 1937. *Onychium japonicum* var. *delavayi* Christ, Bull. Soc. Bot. France 52. Mem I: 60. 1905; Kummerle, Amer. Fern. Jour. 20: 137. 1930.

Tender plant 28-35 cm high; Rhizome short creeping densely provided with pale brown scales; rachis very thin furrowed; sterile pinnae on short stipe; Lamina 12-25 cm; tripinnate at base, bipinnate above; pinnae petiolate, oblique, 6-12 cm, lanceolate 5-8 jugate, pinnules pinnate, 3-5 jugate, ultimate segment linear, 5-8 mm x 1.0-1.5 mm, margin obscurely denticulated, texture very thin membranaceous, pale brown in colour; vein prominent, one to each segment; sori 3-7 mm long; indusium grey, margin deeply erosed.

Specimens examined:

ARUNACHAL PRADESH — Kameng: left bank of Dirang river, 30.10.1970, *Rao* 49477 (CAL).

Earlier record: China.



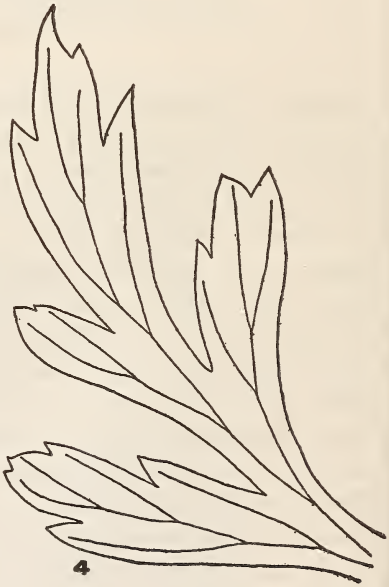


Fig. 3. Sorus of *O. tenuifrons* Ching with indusium showing erose margin. Fig. 4. A pinnule of *O. tenuifrons* Ching.

According to R. C. Ching this species is endemic to China. But the present study shows and its area of distribution extends to Arunachal Pradesh in India.

Botanical Survey of India,
Sibpur, Howrah,
February 11, 1981.

ANJALI (DAS) BISWAS
S. R. GHOSH

REFERENCES

Ching, R. C. (1934): On the genus *Onychium* from the Far orient. *Lingnan Sci. Jour.* 13(3): 500.

Ching, R. C. (1937): Icones Filicum Sinicarum Fasc. 4. Pl. 163, Fan Mem. Inst. Biol. Peiping.

41. *ELAPHOGLOSSUM CEYLANICUM* KRAJINA EX SLEDGE — A NEW RECORD OF FERN FOR INDIA

(*With five text-figures*)

During the study of Herbarium specimens housed in CAL Herbarium I came across a few specimens pasted on one sheet from Sikkim which have been identified as *E. ceylanicum* Krajina ex Sledge. This was previously reported from Ceylon only but the study shows that this species also occurs in India. This is an addition to the 7 species already reported from India. Detailed description and illustration is provided in this note.

Elaphoglossum ceylanicum Krajina ex Sledge

Rhizome creeping, covered by linear, dark chestnut or almost black glossy scales margin of which provided with concolorous setiformis teeth; Fronds tufted several from a stock, simple pinnate, stipe short 1.5-6 cm long, thin, dull brown to reddish brown in col., scaly, scale narrowly lanceolate, light brown, membranaceous, margin provided with dark almost black setiformis teeth; Lamina 8-25 cm x 1-2 cm, oblong elliptic, base attenuate, apex acute to shortly acuminate, texture thin, lower surface dark green, upper surface dull green, both the surfaces scaly but neither surface covered by dense coating of scales, scale of both surfaces vary in shape — broadly to narrowly ovate or sometimes orbicular margin of which fringed by long setiformis teeth. Fertile frond like sterile frond.

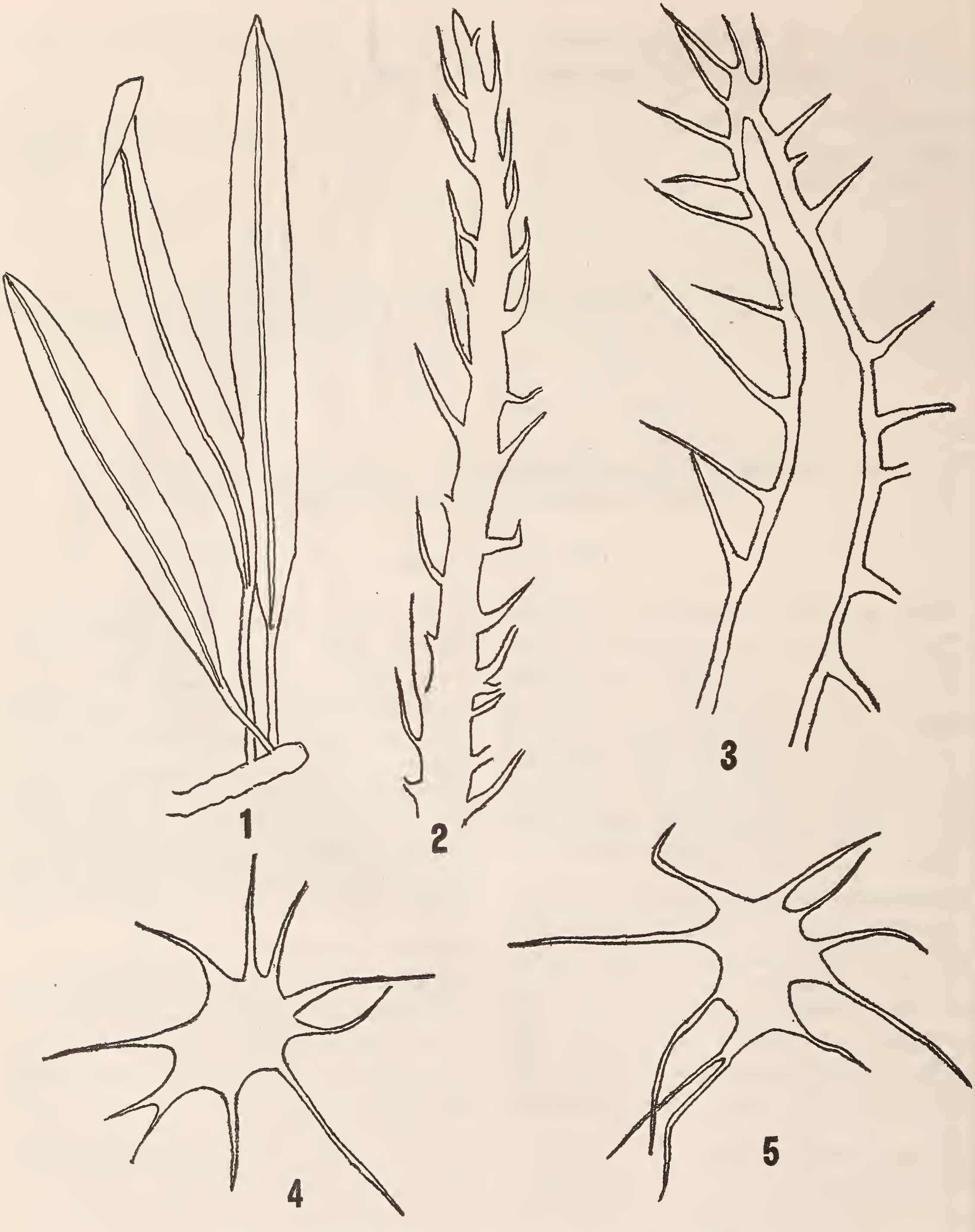
Specimens examined:

SIKKIM — 4000′, 13.4.1857, *Thomson* Acc. No. 25288 (CAL). *Earlier Record*: Ceylon.

According to Sledge this species is endemic to Ceylon (Sri Lanka) but it is now recorded from India.

ANJALI (DAS) BISWAS

Botanical Survey of India,
Sibpur, Howrah,
April 20, 1981.



Figs. 1-5. *Elaphoglossum ceylanicum* Krajina ex Sledge.
1. The whole plant; 2. Scale of Rhizome; 3. Scale of stipe; 4. Scale of upper surface of lamina; 5. Scale of lower surface of lamina.

BOMBAY NATURAL HISTORY SOCIETY

A Special General Body Meeting of the Bombay Natural History Society convened by the Executive Committee to consider two resolutions amending the Memorandum of Association of the Society was held on Friday, the 17th February 1983 at 6 p.m. at the BEST Conference Hall. The following were present.

1. Mr. Amin M. Tyabji
2. Mr. Naresh Dutt
3. Mr. K. Bhasker Rao
4. Mr. J. C. Daniel
5. Mr. H. Abdulali
6. Mr. S. G. Monga
7. Mr. Nitin Jamdar
8. Mr. K. T. Ravi Varma
9. Mr. U. A. Mehta
10. Mr. R. Sahgal
11. Mr. Bittu Sahgal
12. Mr. M. D. Agharkar
13. Mr. Saleem S. Khamkar
14. Mr. Rishad Naoroji
15. Mr. K. N. Naoroji
16. Mr. S. N. Mistry
17. Mrs. D. S. Variava
18. Dr. Salim Ali
19. Dr. A. N. D. Nanavati
20. Mr. F. N. Husein
21. Mr. D. P. Banerjee
22. Mr. M. K. Potdar
23. Mr. K. K. Vajifdar
24. Miss Usha Ganguli
25. Mr. O. S. Fernandes
26. Dr. C. V. Kulkarni
27. Mr. Aroon Tikekar for Dr. Tarneja
28. Dr. S .R. Amladi
29. Mr. D. J. Panday
30. Mr. J. P. Irani
31. Mr. Ashraf I. Macchiwalla
32. Mr. S. M. Ketkar
33. Miss Sober S. Driver
34. Mr. V. K. Paralkar
35. Mr. M. C. Shah
36. Mr. S. V. Paranjape
37. Mr. Y. C. Thakkar
38. Mrs. R. Panthakee
39. Mr. A. V. Ghangurde
40. Mr. Bansi Mehta
41. Mr. Suresh Bhatkal
42. Mr. S. V. Parande
43. Dr. Pradeep Salgia
44. Mr. Robert J. D'Souza
45. Mr. V. James
46. Mr. Ram V. Jethmalani
47. Mr. Dilip Patil
48. Mr. S. M. Thomas
49. Mrs. A. J. Jehangir
50. Mr. N. Kandhari
51. Mr. Anil Dave
52. Mr. D. I. Solanki
53. Mr. Vishnu Mathur
54. Mr. Ulhas Rane
55. Mr. G. L. Kalro
56. Mr. Ranbir Singh
57. Mr. Firoze Mistry
58. Mr. C. B. D'Lima
59. Mr. S. D. Bhaumik
60. Ms. A. A. Kaikini
61. Mr. S. H. Dhami

Dr. Salim Ali, the President of the Society proposed Dr. C. V. Kulkarni to take the Chair and conduct the meeting, which was seconded by Dr. A. N. D. Nanavati.

Dr. C. V. Kulkarni read out the Resolutions

1. RESOLVED that at the end of object 2(a) of the Memorandum of Association of the BNHS., the following be added: "and to promote conservation of nature and natural resources".
2. RESOLVED that the Memorandum of Association of the Bombay Natural History Society be amended by deleting object 2(d).

Dr. C. V. Kulkarni stated that no full length explanations on the two Resolutions were necessary as the explanations have been already circulated explaining why such amendments were necessary. As there appeared to be some disagreement in the minds of members present on the question of proxies, the Chairman requested Mr. M. D. Agharkar, a practising lawyer, to explain the position to members present.

Mr. Agharkar stated that the Society's rules were quite clear on the matter. Rule 13 read with Rule 19 of the Society's Memorandum of Association and Rules and Regulations laid down quite clearly that only members who had paid their subscription for the current year were entitled to attend and vote at this meeting. If the members voting in person or by proxy and supporting the resolutions constituted more than 3/5th of the present paid-up membership, the Resolution could be passed.

The Honorary Secretary announced that the number of members entitled to vote at this meeting was 1240, and 3/5th of this figure would be *744*. He then called for volunteers from the audience to act as scrutinizers and count the proxies received, while the film announced would be shown to the audience.

Mr. Nitin Jamdar, Mr. R. Naoroji, Mr. Parande, and Mr. Ulhas Rane volunteered to count the proxies, along with the Honorary Secretary in another room.

Meanwhile the film 'Monsoon Birds" made by Stanley and Belinda Breeden was shown to the audience.

The Honorary Secretary then announced that 935 valid proxies, all supporting the two resolutions, had been received and 60 members were present at the meeting.

Resolution No. 1 was then put to the vote and was passed unanimously.

Resolution No. 2 was put to vote and was also passed unanimously.

The total of 993 votes recorded being well above the required minimum of 3/5th, i.e. 744, both the resolutions were declared to have been carried.

The meeting terminated with a vote of thanks to the four volunteer scrutinizers and to the Chair.

BOMBAY NATURAL HISTORY SOCIETY

The Second Special General Body meeting of the members of the Bombay Natural History Society was held on Thursday, 17th March 1983 at 6 p.m. at the BEST Conference Hall, to confirm the resolutions passed on 17-2-83, when the following members were present:

1. Mr. S. K. Tyagi
2. Mr. P. N. Navalkar
3. Mr. J. N. Barmeda
4. Mr. A. A. Dikshit
5. Mr. Andrew A. Rao
6. Dr. A. N. D. Nanavati
7. Mr. K. Bhasker Rao
8. Mr. H. K. Divekar
9. Ms. Usha Ganguli
10. Mr. Oswald Thayil
11. Mr. G. D. Uttam
12. Ms. Smita Patil
13. Mr. G. M. Gidvani

14. Mr. Naresh Dutt
15. Mr. K. R. Lobo
16. Mr. J. C. Daniel
17. Mr. R. Ashok Kumar
18. Mr. C. G. Gariba
19. Dr. C. V. Kulkarni
20. Mr. H. Abdulali
21. Mr. S. S. Sharma
22. Mr. M. D. Agharkar
23. Mr. J. T. Munsiff
24. Mr. K. K. Vajifdar
25. Ms. A. A. Kaikini
26. Mr. John Mascarenhas
27. Mr. Nitin Jamdar
28. Mr. N. V. Aidyanathan.

Dr. A. N. D. Nanavati, the Honorary Secretary, informed the audience of the inability of Dr Salim Ali, the President, to attend the meeting, and proposed Dr C. V. Kulkarni, the Vice-President of the Society, to the Chair. This proposal was seconded by Mr. J. N. Barmeda.

The Chairman reiterated the purpose of the meeting called for and stated that he was going to read the Resolutions and to put them to vote one by one.

Resolution No. 1. RESOLVED that at the end of object to 2(a) of the Memorandum of Association of the Society the following be added: 'and to promote conservation of nature and natural resources.'

The Resolution was put to vote, twenty six members voting for it with two abstaining. None was against the Resolution. The Resolution was therefore declared confirmed.

Resolution No. 2. RESOLVED that the Memorandum of Association of the Bombay Natural History Society be emended by deleting object 2(d), namely: "To carry on the business of Taxidermists and preservers."

The Resolution was put to vote, once again twenty six members voting for it with two abstaining. None was against the Resolution. The resolution was therefore declared confirmed.

The Chairman thanked the members for attending the meeting.

The Honorary Secretary moved the vote of thanks to the Chair.

The film GORILLA based on the Mountain Gorillas of the Zaire region of Africa was shown and highly appreciated by the audience.

Dr. C. V. Kulkarni
Vice President,
and Chairman of the Special
General Body Meeting,
Bombay Natural History Society.

ERRATUM

Volume 79(2) : August 1982

On page 331, Title,

and Table of Contents,

TAXONOMIC SIGNIFICANCE OF SPERMATHECA IN SOME INDIAN GRASSHOPPERS (ORTHOPTERA: UCRIDIDAE)

For 'UCRIDIDAE' *read* 'ACRIDIDAE'

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Bombay Natural History Society

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AUGUST 1983 Rs. 45

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1983 AUGUST Vol. 80 No. 2

OBSERVATIONS ON THE CRESTED SERPENT EAGLE (*SPILORNIS CHEELA*) IN RAJPIPLA FORESTS — SOUTH GUJARAT[1]

RISHAD K. NAOROJI AND S. G. MONGA

(*With five plates and a text-figure*)

INTRODUCTION

The Rajpipla forests comprise the highland area at the western extremity of the Satpura range between the Tapti and Narmada rivers (21°50′N 73°30′E). The forests get the name from the nearby Rajpipla town, capital of the former princely state of Rajpipla, in which these forests were included. The forests are basically of two types : Tropical semi-evergreen and moist-deciduous. There are some excellent patches of forests remaining around Juna Raj, Namgir and Piplod areas of both bamboo and moist-deciduous types. This area of the Satpuras is of great importance in Indian ornithology and it is almost the meeting point of the northernmost end of the Western Ghats with the westernmost tip of the Satpura range which in itself has been regarded as an ornithological highway in Indian Ornithogeography (Sálim Ali — Guj. Res. Soc. Vol. 10).

We first visited these forests in June 1981 for the sole purpose of assessing its potential for photographing the bird life with a possible emphasis on raptors. Within a few days we observed a great concentration of the Crested Serpent Eagle, *Spilornis cheela,* and other birds of prey for which unfortunately we were too late that year. As the Serpent Eagle was still breeding here in June, the help of the local adivasis was sought and within a few days five nests of this eagle were located. We then concentrated on observing in detail the behaviour and nesting habits of the eagle. Though this eagle is common throughout the subcontinent, there is little available information on it. Besides, it may also be added that during our visits to these forests we observed several birds hitherto not recorded from this area.

METHODS

Most of the observations on the Crested Serpent Eagle were made from hides. Over

200 hours of observations were made from hides during photography sessions. The birds were also observed to a lesser extent on foot, while moving about in the forests from hill tops and in the valleys.

The peninsular Indian race, *Spilornis cheela melanotis* (Jerdon) is resident in peninsular India south of the Gangetic plain, arbitrarily south of lat. 25°N, from Gujarat east to Bengal and south to Kanyakumari (HANDBOOK Vol. I, pp. Salim Ali & Ripley). Besides these two, there are four more races confined to Sri Lanka, Burma, Andamans and Nicobars.

As mentioned at the outset, we first reached these forests in January 1981, when these eagles could be commonly heard from almost every hill and valley. It was not easy initially locating the birds as we were still inexperienced in finding nests, we thus recruited local help for doing so and this proved rewarding. Eventually, five nests were located. Among these, one found on the 18.vi.1981 afternoon had been tampered with and part of the nest was lying on the ground. Our adivasi cook, Naika, spread word around and on the 19.vi.81 morning during a five hour walk beginning at 3.30 a.m. two more nests were located — one of these in a hopeless location for photography, high up on a very big tree on a massive hill. An adivasi boy hired to climb the tree to check its contents had almost reached the nest, when an eagle which had been sitting very close erupted into action and flew off, unsettling the boy considerably. The nest was empty. The nest was very large and as it was very early in the morning, the eagle was probably using it as a roost. About this nest it may be added that it was the largest Serpent Eagle nest that we saw in the Rajpipla forests. One other nest found in the Murud-Janjira forests, south of Bombay, compared with this nest in size. The second nest located by Bhanga our main adivasi helper was rather small in size. In fact on first sighting it appeared to be a loose collection of twigs and sticks. Bhanga climbed the tree and reported that it contained a nestling. To prove it, he picked up a small downy eaglet from the nest and showed it to us before replacing it back in the nest. A long wait then ensured the confirmation of the identity of the eagle. The same morning we were shown another nest of *Spilornis cheela* near Sankhri village. The nest at Sankhri was also not a large one and contained a fully fledged eaglet (Plate I), which was initially invisible as it was sitting very close and stood up in the nest only when an adult arrived calling and perched nearby. Near Namgir, Bhanga showed us two more nests of this eagle but both were empty. The construction of the machan for photography commenced on 22.vi.81 working for about an hour each day. Five adivasis under our supervision completed the machan by 29.vi.81. The following year, 1982, another nest near Namgir was observed and photographed. (Plate I).

Spilornis cheela melanotis (Jerdon) is common in the Rajpipla forests. As a matter of fact, we would not hesitate to consider this eagle as abundant in these forests.

On occasions when the chick was about 15 days old and not brooded continuously we observed the eagle in the afternoons, perched on a high branch of some large tree overlooking the nest, keeping a watchful eye on the eaglet.

On the only day that SM entered the hide on 11.vi.82, a roller was observed to alight on the nest tree a few feet above the nest calling harshly. This immediately elicited a response and both adult eagles appeared at the nest — the only time they were seen together. The roller flew off immediately. With both

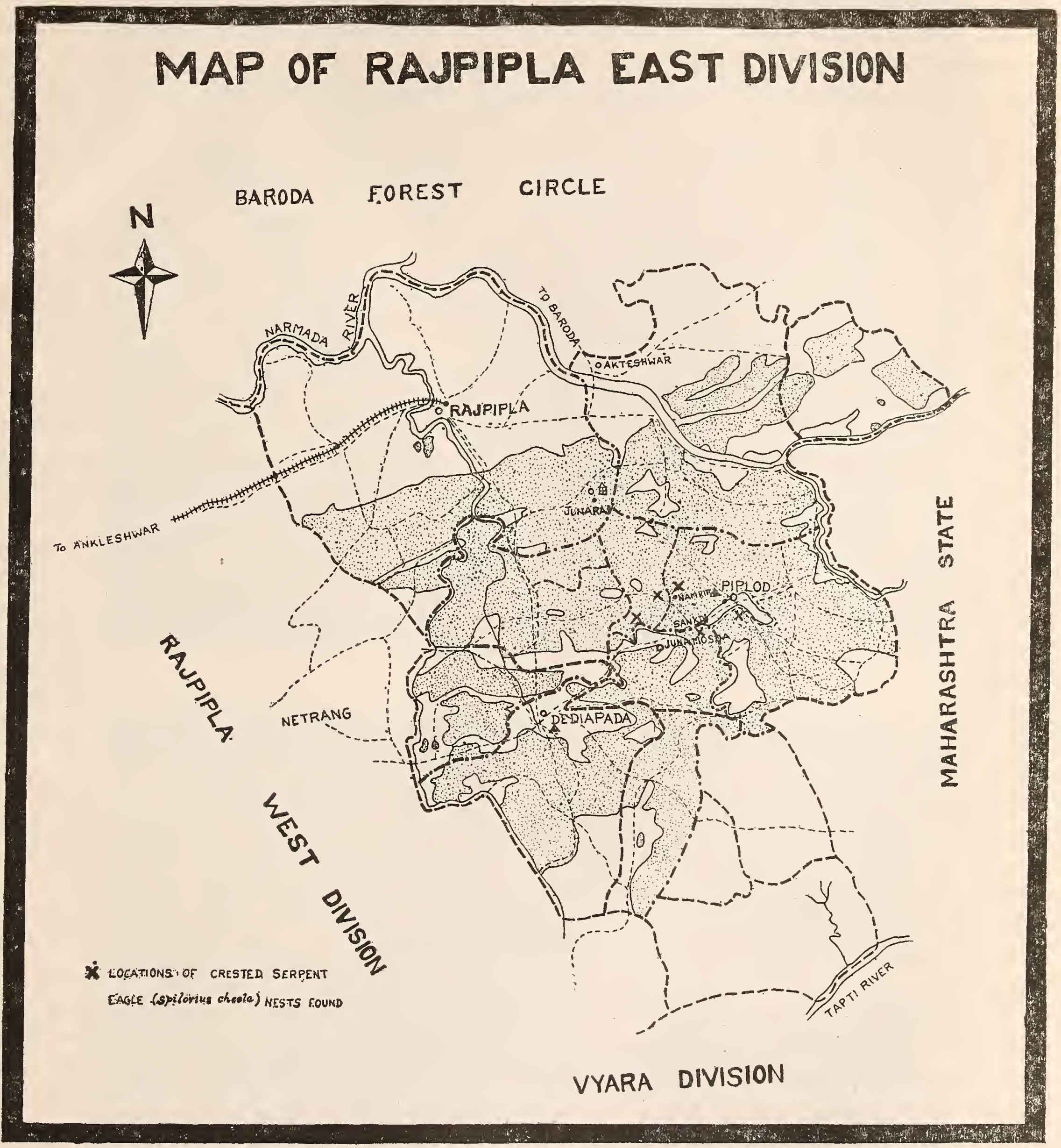

MAP OF RAJPIPLA EAST DIVISION
BARODA FOREST CIRCLE
N
NARMADA RIVER
TO BARODA
AKTESHWAR
RAJPIPLA
To ANKLESHWAR
JUNARAJ
NAMKIRA
PIPLOD
SANKDI
JUNAMOSDA
NETRANG
DEDIAPADA
RAJPIPLA WEST DIVISION
MAHARASHTRA STATE
TAPTI RIVER
VYARA DIVISION
✖ LOCATIONS OF CRESTED SERPENT EAGLE (Spilornis cheela) NESTS FOUND

Fig. 1.

eagles at the nest comparison was relatively simple. One of the birds was distinctively smaller in size and lighter in colour. Both eagles must have been in the near vicinity to arrive at the nest as normally only one of the eagles was somewhere around near the nest. Besides these, some 16 other birds were observed to alight on the nest tree: for example, the little sun-bird which flitted and hovered at the very rim of the nest and performed aerobatics right in front of the nestling which stared at them in fascinated concentration. Other than a stray roller and a jungle myna, no other large bird was seen on the nest tree, though on one occasion when an adult Serpent Eagle was perched near the nest two others were circling and calling about 200 feet above the nest. On yet another occasion, I (RKN) saw a large unidentified raptor flying past the nest without unduly alarming one of the adults which half-heartedly followed it for a short distance. A pair of the same birds of a different species were noticed around a large nest nearby (70 metres from the *cheela* nest) and did not seem to be alarming the serpent eagles. Leslie Brown has observed that different species of African Raptors nesting in close proximity to each other are generally tolerant of each other, but not to the same species. Visits to the nest would decrease and sometimes no adults would be seen for 6-7 hours when the eaglet was in the secondary downy stage. During the eaglet's first two and a half weeks the female — would spend most of the time brooding particularly continuing after the cool hours of the morning are over, till late evening after it had cooled. The adult bird would tuck in the eaglet and sit lightly over it, panting due to the heat. Brooding would be interrupted when the male arrived with the food and during feeding. On some days when extra snakes are caught the prey would be dropped into the nest next to the eaglet and brooding would recommence without feeding. The brooding female, had an outpost on a nearby tree overlooking the valley below on one side and on the other the nest. It was on this perch that she would spend the early hours of the morning and evening when it was cool.

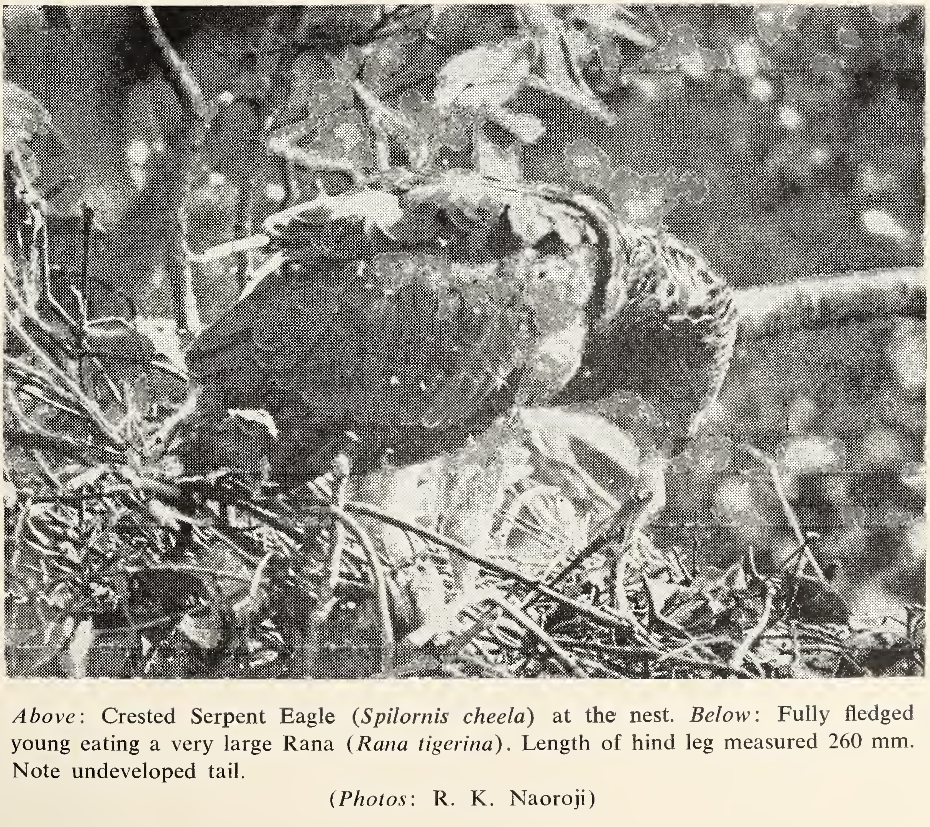
NEST & EGG

In Rajpipla forests we noticed that the nest of *Spilornis cheela* distinctly appears small for a bird so big. This has also been observed and written about by several earlier authors. In fact it may be stated that the very first occupied nest of *Spilornis cheela* that was located and checked on 20.vi.81 was so small and ill-made that it seemed rather hard to believe that this particular nest actually contained a nestling and that too of an eagle. Most of the other nests that we observed in this area were of a rather small size, with a diameter of about 1½ feet. Nests of *Spilornis cheela cheela* vary in size from 1.5-2 feet in diameter and from "4-8" inches in thickness (Hume: Nests & Eggs of Indian birds, iii, p. 154).

We observed that the nests of this race are never on the top of trees but always somewhere half-way to ¾th way up, on some fork, often one jutting from the main stem.

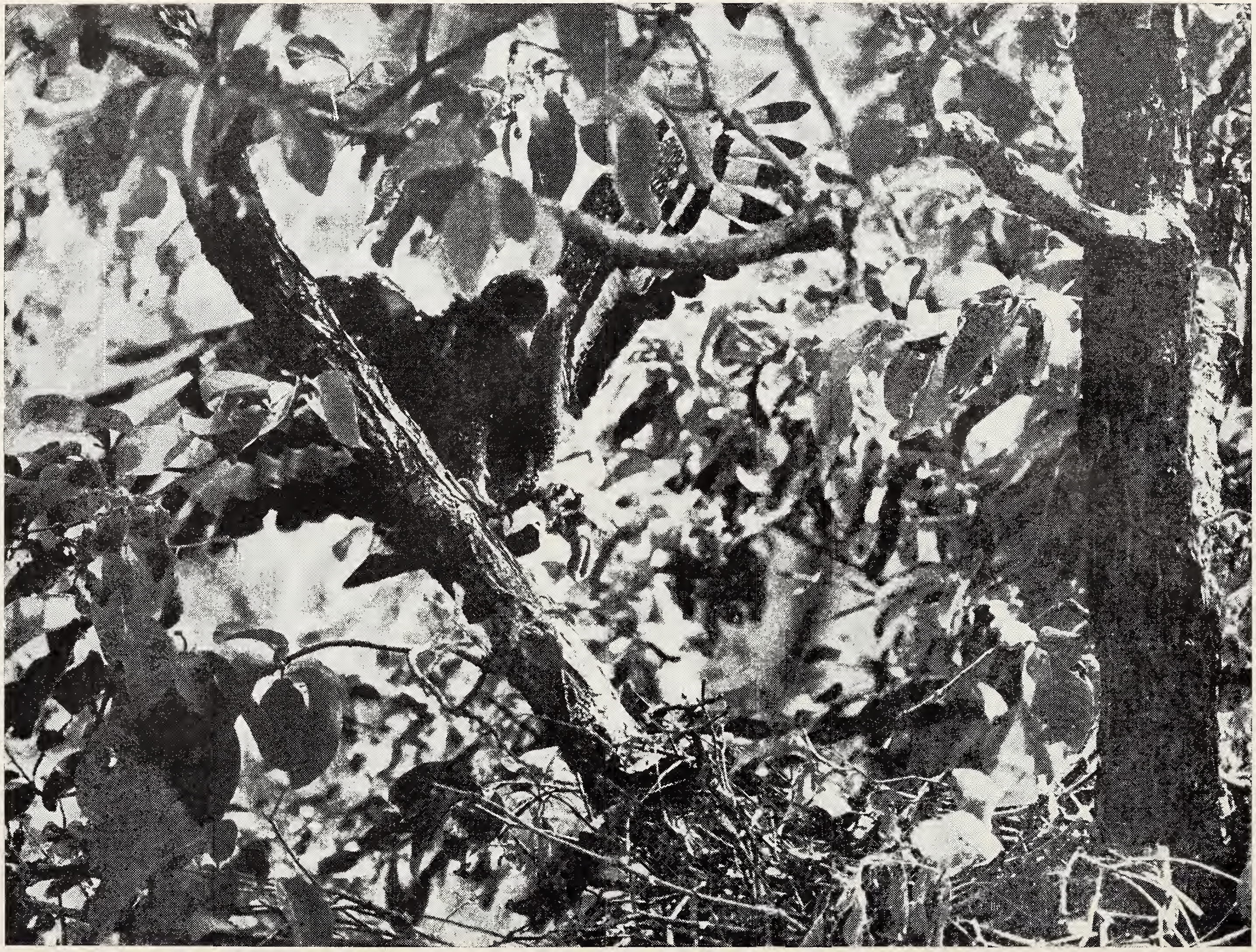
From among the nests we observed and checked it was noted that the nest-cup is deep and is lined with green leaves and twigs. We never actually saw the eagles bringing any leaves or twigs even though we saw fresh leaves and small branches often in the nest. Perhaps, Major Cock's surmise about *Spilornis cheela* using twigs and leaves of the very tree on which it nests, for its nest, holds true for *Spilornis cheela melanotis* too.

The depth of the nest in the half a dozen nests we actually checked varied from a few



Above: Crested Serpent Eagle (*Spilornis cheela*) at the nest. *Below*: Fully fledged young eating a very large Rana (*Rana tigerina*). Length of hind leg measured 260 mm. Note undeveloped tail.

(*Photos*: R. K. Naoroji)



Adult Crested Serpent Eagle (*S. cheela*) bringing half-eaten unidentified mammal in left foot to the nest.
(*Photo*: R. K. Naoroji)

inches to slightly over a foot. In one of the nests observed on 19.vi.81, the nest cavity was exceptionally deep. SM on one occasion was a good way above the level of the nest and could clearly look into it. It was only when an adivasi boy had climbed to within a few feet of the nest that the bird flew off. Inspite of being above the nest at a favourable angle, the eagle was not visible and this also supports the view held by others that *Spilornis cheela* is a very close sitter. Leslie Brown has noticed this among African Snake Eagles and also Baker (NIDIFICATION Vol. 4). On another occasion RKN climbed to a nearby hillock but was still unable to see the contents of a nest. Our aim being to photograph these eagles, it was decided to sit nearby and observe the nest to see if it was occupied. After an hour, the characteristic three-bar call of an adult serpent eagle was heard and minutes later, the bird arrived, alighting on a tree 25 feet away from the nest-tree calling vociferously. The nest which had looked empty came to life and a fully fledged juvenile stood up and called as energetically as the adult. It had been till then sitting tightly on the nest, making no sound at all to give its presence away. Baker (NIDIFICATION Vol. IV) writes that *Spilornis cheela* often adds fresh material to its nest every year as a rule, though sometimes they lay in the most dilapidated and ill-repaired nest. Judging from the nests we checked we feel that only occasionally does this eagle add fresh material and hence rarely uses a particular nest for several successive seasons, though on rare occasions a nest might be used successively. The two large nests found, one in Rajpipla used for a nightly roost and another in the semi-evergreen forest of the Murud-Janjira coast, could be exceptions but this is only a surmise.

In Africa, Leslie Brown observed that the Snake Eagles (*Circaetus*) usually build a new nest every year, in close proximity to the previous year's nest site. We feel that the same could probably hold true for the Serpent Eagles in Rajpipla and this should be looked into in greater detail.

From among the seven nests of *Spilornis cheela melanotis* that were observed and checked during two nesting seasons (1981-82), four were on the Sadada (*Terminalia tomentosa*) trees while the occupied nest at Mozda was on a Sheeshum (*Dalbergia sissoo*) tree. The sixth was on a Timru (*Diospyros melanoxylon*) tree and the seventh nest tree remains unidentified.

Judging from the above *Terminalia tomentosa* appears to be a favourite tree of raptors to make their nests. Atleast four nests of the Shikra (*Accipiter badius*) were also on *Terminalia tomentosa.*

In the four occupied nests that were observed, three had one nestling each when first located and only one of the nests contained an egg on 13th May, '82.

We did not check any egg in the Rajpipla forests but the nest which contained an egg found on 13th May, '82 was, according to our adivasi friend, Banga, unmarked dirty-white in colour.

So far in our experiences with these eagles, only one egg/chick has been noticed in occupied nests.

FEEDING & FOOD

As the name of this eagle suggests it largely feeds on snakes and will attack even large sized snakes. Even the rat-snake, some as long as 5 feet are tackled and killed with ease and they seem to destroy poisonous snakes with as little fear as the harmless ones (Baker, FBI: Vol. 5).

The following prey species were observed being brought to the nest during his photographic visits. All species observed were non-poisonous and the main varieties were the tree snakes.

(a) *Snakes*: i) Bronze-back (*Dendrelaphis tristis*) ii) Vine Snake/Whip Snake (*Ahaetulla nasutus*) iii) Rat Snake/Dhaman (*Ptyas mucosus*) iv) Olive keel-back (*Atretium schistosum*) v) Striped Keel-back (*Amphiesma stolata*).

(b) Half-eaten and almost mangled carcasses of a mammal with fur — brought twice — once on 30th May 1982, and on 3.6.'82. (Plate II).

(c) *Lizards*: Two species of lizards were brought to the nest. One of these was easily recognizable as a *Calotes;* the other beautifully mottled in colour like the bark of a tree.

(d) Frog on one occasion, possibly a *Rana.*

(e) Perhaps even junglefowl, domestic fowls and probably other ground birds as reported by the adivasis.

A. Anderson (P.Z.S. 1872, p. 77) writes that *Spilornis cheela* subsists almost entirely on green frogs. Baker (FBI, 5) considers that even though snakes are the principal prey of *Spilornis cheela,* when snakes are not to be found this eagle will eat reptiles, birds of all kinds upto the size of the largest pheasants, partridges and ducks and also grubs and larger insects.

The adult eagles always brought snakes to the nest in their beaks. The mammals though on one occasion were brought in the beak and once in the talons. It seems that heavier and compact prey is brought to the nest in the talons. Probably a snake carried in the talons for the last few metres to the nest might interfere with the landing. On one occasion, a snake was actually seen being killed. While RKN was photographing from the hide SM was observing the hide concealed nearby. Lying thus on the ground, a rustle was heard and a Dhaman seen 25 feet away. Suddenly, a Serpent Eagle landed on the ground a few feet away from the snake. Cautiously disregarding SM it walked briskly towards the snake "like a large chicken" with wings wide-spread. The snake by now trying to make its escape reached the base of a large tree. The eagle had to run around the tree thrice in its attempt to pin down the escaping snake. The third time it managed to sink in its talons just behind the snake's head. After looking at SM fiercely it gave a squawk and flew to a nearby tree with its prey where it commenced to bash and twist it with beak and claw for about 10 minutes. It then flew to a perch behind the hide for 30 minutes before alighting at the nest.

When the snake appeared at the nest it was noticed that it had been beheaded. In EAGLES, HAWKS AND FALCONS OF THE WORLD, by Leslie Brown and D. Amadon, it is stated that *Spilornis cheela* sometimes pick dead snakes and that all prey is taken on the ground.

On 5.vi.'82, some jungle crows were observed mobbing something very excitedly in the vicinity of Mozda village near Namgir where an occupied nest of *Spilornis cheela* was located. Seconds later, a Serpent Eagle, one of the Mozda breeding pair rose from the river bed with a large snake in its talons and settled further along the right bank of the river. On (RKN's) approaching closer for a better look, it left the snake on the ground and flew to a tree across the river. The snake was identified as a 5 ft. rat-snake which had recently been killed as the carcass was far from being stiff. About 8 inches of flesh had been eaten from head downwards, exposing the vertebrae. This pair were observed to hunt along this stretch of river for two consecutive nesting seasons.

The adults arrival with food is heralded by alarm calls of jungle mynas, parakeets and babblers and the parent birds would have a fixed approach or route to the nest, though on rare occasions a different approach would be adopted. The normal route was to fly directly to a large nest-supporting branch to the left of the nest. The final few feet down to the nest would be covered by hopping down with wings partially wide-spread for balance. On two to three occasions an adult was seen approaching the nest directly and alighting on it, and sometimes from the right. The eaglet is fed very carefully and care is taken not to directly step on it. Feeding is done with great delicacy with that fearsome beak and food is generally held out near the beak of the chick which takes it on its own. When the chick is very tiny (about 4 to 10 days old) very small morsels are fed and the chunks of meat torn out and fed increase in size along with the eaglet's growth and capability of handling and swallowing large morsels. Nothing is wasted and slivers of meat that are flicked to the edge of the nest are immediately retrieved and fed. Interestingly enough this has been observed by F. Truslow on the Bald Eagle and I (RKN) have also seen the female Shikra interrupt the feed to retrieve pieces of meat from the nest-rim. The eaglet is coaxed when it refuses to eat and on two occasions an unusual feeding posture was observed and photographed to coax the chick to feed.

On one of her visits to the nest the female could not get the chick to accept even a beak full of food. She tried to coax the chick in a variety of ways. Firstly by calling softly and then by tapping beaks very gently with the chick. The chick, still not responsive to her feeding overtures kept its beak closed whereupon the adult adopted the upside down head posture as shown in the photograph, and this proved successful. (see plate III).

All large snakes e.g., Rat Snakes, were brought beheaded to the nest while small slender tree snakes like the bronze-back and the vine snake were brought with heads intact but battered and swallowed head first by the chick. When the chick was a few days old it was observed that on a few occasions the adult would tear the snake in half and feed the tail end of the snake to the young. The 15 days old chick was capable of swallowing a 3½ ft. Dhaman when very hungry. It would take a rest every now and then looking very comical with the unswallowed tailend hanging out from its beak. On two other occasions when the same species of mammal (unidentified) was brought to the nest the animal had been torn in half and partly mangled. Head and feet were missing but the tail and part of the body was intact. Most probably the other half had been eaten by the hunting partner and was torn up to facilitate carrying it to the nest. Fur, skin and bones — everything was eaten. The eaglet would very often fall into a deep slumber after a heavy meal. Some of the African snake eagles, according to Leslie Brown, swallow snakes and regurgitate them to their chicks which pull them out of the adults' crop. Lizards were brought intact along with frogs to the nest and on one occasion a lizard was observed being torn lengthwise. On yet another occasion a lizard brought to the nest was torn in half and fleshy morsels from both halves were fed to the chick. Then the halves were separately swallowed by the eaglet. Sometimes while feeding the chick the adult also feeds itself but leaves the choicest fleshy parts for the chick.

On many occasions food in the form of snakes would be stored in the nest. Once a snake was brought and dropped beside the chick. The adult brooded the chick till late afternoon after which she fed the morning's catch to the chick. The same was observed with a carcass of a mammal present in the nest and fed later. On another occasion, I (RKN) entered the hide in the afternoon after a heavy morning's rain had subsided and present in the nest along with the chick was a large Dhaman. An adult could be seen from the peep-hole perched nearby. Later a crescendo of eagle calls were heard close to the nest and to the accompaniment of myna's alarm calls an adult arrived with a longish Bronze-back (head intact) (see Plates IV & V) and merely dropped it into the nest, along with the rat-snake. The female brooded for an hour and a half and then flew to her favourite evening perch overlooking the nest and the valley below. Later in the evening after the chick had called hungrily for some time she appeared at the nest and fed small morsels of the rat-snake to the eaglet. This storage of food was seen on a number of occasions. After the chick is about 20 days old, brooding decreases and the adults visit the nest for the sole purpose of bringing food. As the fledgling get older and can tear up prey on its own, these visits become extremely short and only two or three minutes are spent at the nest after dropping in the food. Food bringing intervals also increase and later during the young's development only one or two food bringing visits are made during the day. As prey species are more easily found during the rains, we found many nests occupied at the outset of the monsoon and nesting carried on sometimes even into August, though most nested during the months of end May to July coinciding with availability of prey species. Tree snakes too would be easier to hunt during the rains.

Most of the feeds that were observed were generally in the late afternoons and the late morning hours. Some kills must have been made very early in the morning as on several occasions snakes were seen present in the nest at 8 a.m. when the previous evening at dusk no prey was observed in the nest.

VOICE AND CALLS

On our very first day in these forests in June 1981, we could commonly hear the calls of this eagle. There was not a single day on our trips, when we did not hear *Spilornis cheela*. We observed that this eagle has a good variety of calls and is very vocal during its breeding season.

The ordinary call notes of *Spilornis cheela* are loud and high pitched whistling screams, something like Kek .... Kek .... Kek, or Kee.... Kee.... Kee, while soaring but sometimes also from a perch (Sálim Ali and Ripley, S. D. in Handbook Vol. 1, p. 331).

The calls of *Spilornis cheela* are among the commonest raptor calls we heard in the Rajpipla forests. It was noted that *Spilornis cheela* is much more vocal when soaring high up rather than when perched.

Davison (SF: X, p. 337) on *Spilornis cheela melanotis* (the peninsular & south Indian bird) writes, "Silent as a rule when seated. Occasionally as it flies and takes off it utters its wild plaintive note, more often when circling up".

We feel that the calls of *Spilornis cheela melanotis* (we strongly suspect it to be *melanotis*) have not been properly described. The commonest call of this bird, that we heard in the Rajpipla forests can be best described as:

(a) phtueeeee........ tue........ tueeu

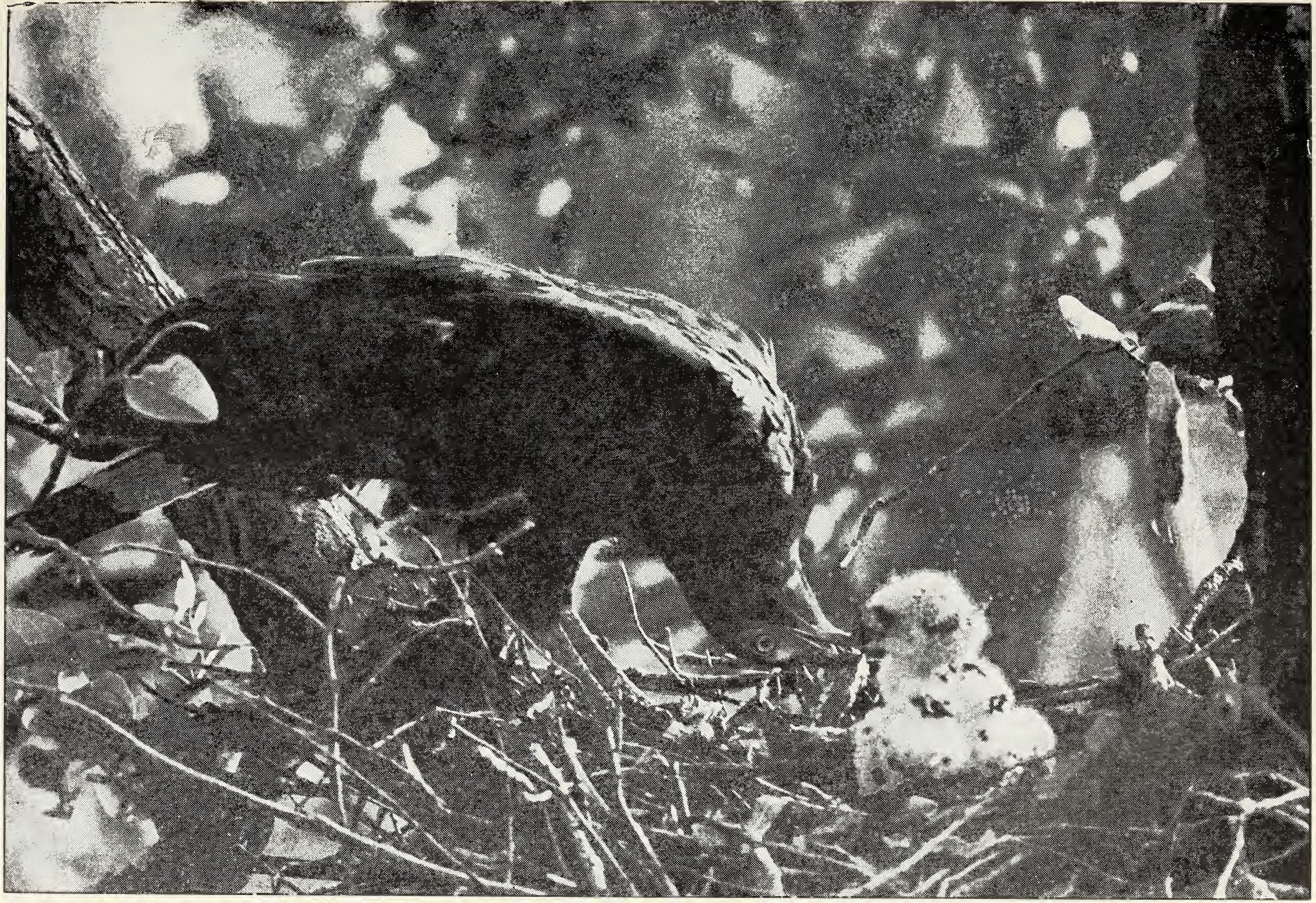
or

Kueeeee........ Kue........ Kueeeh

(I) (II) (III)

in three syllable notes.

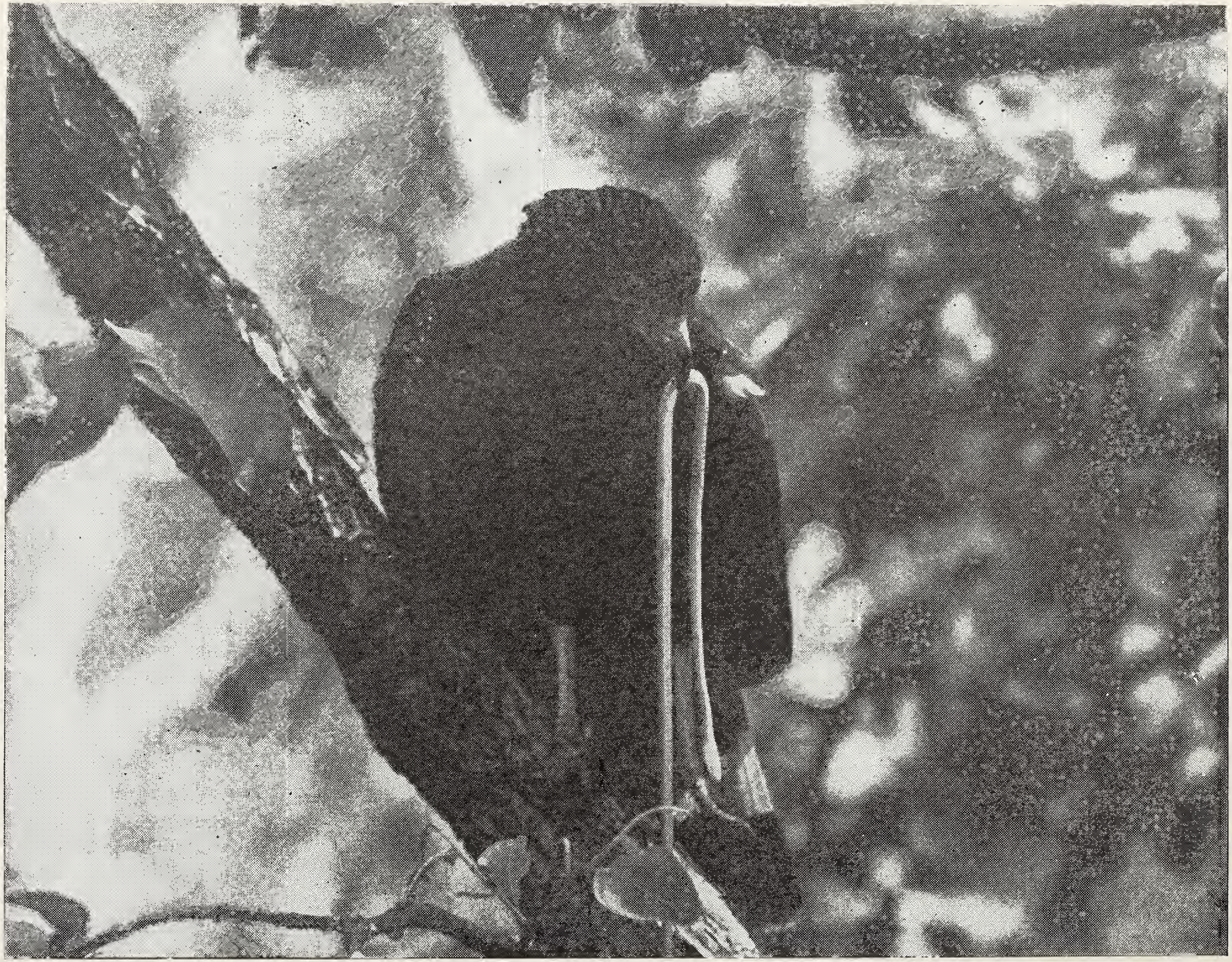
The first note of *Spilornis cheela* that we so



Unusual feeding behaviour of the Crested Serpent Eagle (*S. cheela*).

On one of her visits to the nest the female *S. cheela* could not get the chick to accept any morsel of food. She tried to coax the chick in a variety of ways. Firstly by calling softly and then by tapping beaks very gently with the chick. The chick still did not respond and kept its beak closed whereupon the adult adopted the posture as shown in the photograph and this proved successful.

(*Photo*: R. K. Naoroji)



Bringing a Bronze-backed snake to pre-feeding perch.
(*Photo*: R. K. Naoroji)

commonly heard in Rajpipla is considerably longer being almost twice as long as both the following notes together. Most authors have described the first note of *Spilornis cheela* as very short and 'almost fading away'.

(b) Frequently this eagle, when perched in the afternoons somewhere high up on a large tree overlooking the nest utters a shrill, prolonged whistle Keeeee.......... which would be repeated as many as 5-6 times in quick succession.

A rather harsh single note was heard on 11th June, 1982. One of the adult birds was perched on a nearby tree not far from the nest when it suddenly emitted a harsh 'Khweerar......'. This particular note was also long drawn and it was the only time this call was heard.

As the Serpent Eagles were vocal at their nest, a variety of calls of different intensity and cadence were heard and it was noticed that they are particularly vocal when prey is brought to the nest. There are often many variations in the tone but the most frequently heard call was the triple syllabled "Keeeu...... Keu..... Keu," the first note being extremely prolonged.

Most of the time, for the first few days of the eaglets life, the adult female *Spilornis cheela* would be brooding at the nest and for long periods there would be absolutely no sign of her mate. On many occasions it was noticed that during brooding the female would look skywards and let out a shrill croak or a 'squawk' as if summoning the male. This squawking call was totally unlike the yelping whistling screams typical of the Serpent Eagle. If the mate arrived with prey the female would fly off voicing this unusual squawk. The male would then reply — a true rendition of a Serpent Eagle call and after a wait of generally about twenty minutes or even more or less the pair would be seen perched on a nearby tree with a snake or the female would directly fly to the nest with food within a few minutes.

On 2nd June 1982, the nestling was left unattended for what seemed to be the longest period observed. In the afternoon after 5 hours of being left alone the eaglet called incessantly. Suddenly with a swoosh of wings, the female alighted on the nest. She brooded for the next fifteen minutes and then emitted her squawking call and flew away calling characteristically 'Keeeu... keu... keu'. She circled low above the nest and continued calling thus. Soon she was answered by her mate and after disappearing for just a few minutes, arrived with a lizard.

From these similar observations it appears that the squawking call is synonymous to the female's recognition call, and was also heard when the eagle at the nest was suddenly surprised by the presence of the mate in the vicinity or when he arrived with food.

The squawk of *Spilornis cheela* appears to be reminiscent of the alarm call of the Great Indian Horned Owl (*Bubo bengalensis*) and I (RKN) also liken it somewhat to the call of the Night Heron (*Nycticorax nycticorax*).

Almost 60 per cent of our approaches to the hide were greeted by the calls of *Spilornis cheela.* I (RKN) would particularly like to mention 3rd June 1982. On this day the eagles were more vocal than on any other day. Some of their calls were extremely high-pitched and penetrating, and variations in tone, pitch and half-notes were clearly discernible and difficult to describe in writing. Even when the pair were away from their nest and soaring high up, their calls were clearly audible at intervals throughout the day.

On another visit during the nonbreeding season during December-January, we always heard these eagles while they soared, though not as frequently as they were heard during their breeding season. Often a pair could be calling and replying to each other. I (RKN) feel that these calls, of *Spilornis cheela,* could be a means of communication, efficient for and instrumental in maintaining a territory, possibly throughout the year. In March/April 1980, when we were in the forests of Murud-Janjira, some 200 kms. south of Bombay in Maharashtra, we observed four adult *Spilornis cheela* together skimming low over the hills, sometimes only 30-40 ft. above us, calling persistently to each other loudly and penetratingly for over twenty minutes at a stretch, after which they started soaring and were soon out of sight. Breeding was probably beginning in this area though we did not check the huge nest.

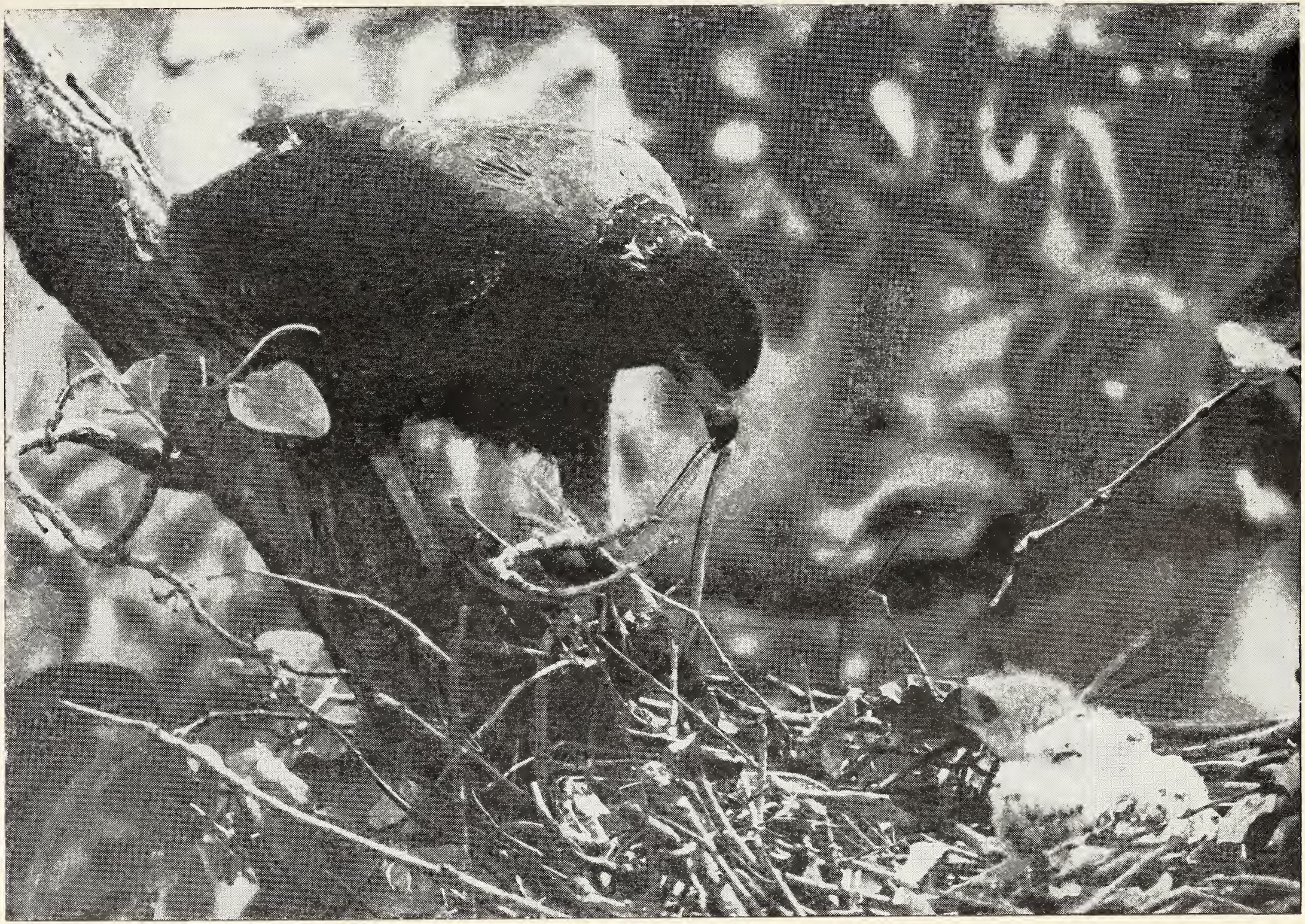
There was no apparent visible aggression at all between these four eagles but it was obvious that they were two pairs. This happens to be one of the many occasions when I (RKN) saw more than two *Spilornis cheela* together. The memory, of their calls echoing loudly across the valley is not easily forgotten.

The young *Spilornis cheela* eaglet has a call much more similar to the clucking of a hen "cluk.... cluk.....". We feel that the calls and noises emitted by the eaglet of *Spilornis cheela* have never before been described.

The down covered eaglet when nearly ten days old (28.v.82) would emit a faint but nevertheless penetrating and enchanting "cheep ...... cheep....". After about 15 days the call changed to a very weak one syllabled whistle incorporating all three syllable adult calls in pitch. However, intermittently the eaglet frequently uttered its cluk.... cluk.... and this clucking was prominent even when the eaglet was almost ready to leave the nest and also on the day it was last observed to be present at the nest. The change in the calls of the eaglet was distinctly noticeable. Calls were also used to probably entice the fully fledged chick out of the nest or even to reassure it. At the Sankri nest an adult eagle was observed to have called characteristically and then alight on a tree opposite the nest 25 ft. away calling continuously. No prey was brought and the juvenile reacted instantly, standing on the edge of the nest and calling. Its call was not as resonant as the adult's and consisted of a one bar note.

Calls frequently heralded prey being brought to the nest and the female would utter a squawk and fly off. The male would call characteristically and the female would reply. Minutes later, an adult would fly to the nest with food. When the chick was half grown the adult sometimes arrived with prey and perched nearby, calling to the chick and being repeatedly answered. This exchange of calls would go on for a few minutes after which the adult would alight on the nest with food. Normally after a snake is caught the eagle waits for a while till the more vigorous movements lessen. It then flies to a perch near the nest and calls. It is answered by both eaglet (if it is about 25-20 days old) and also sometimes the mate. A long wait (sometimes even 45 minutes or more) before alighting at the nest is often punctuated at intervals by vocalising. On no occasion has the senior author observed a snake convulsively thrashing in its death throes being brought to the nest. When the eaglet is hungry it keeps on calling. A weak "cheep ......cheep...." not unlike that of a coppersmith but less metallic and at varying intervals. This galvanizes the brooding adult to look impatiently skywards and utter an impatient squawk. Usually when one of the adults sits lightly on the chick all its calls immediately stop.

PLATE V



Bringing a Bronze-backed snake in the nest.
(*Photo*: R. K. Naoroji)

THE EAGLET

The young Serpent Eagle when first seen (about 3 days old) was completely covered with white down (prepennae stage). It was a fluffy white ball and when first observed from the hide on 28th May (when 11 days old) the eaglet would emit a faint but penetrating "cheep, cheep" call. It would move about in the limited expanse of its nest and appeared quite restless.

For the first 15 days, the eaglet is brooded for most of the day by the female. After this the eaglet is left by itself for longer periods though normally one of the adults is not far away. The feathers on the eaglet's nape, neck and wings are now visible and grow considerably. This, Leslie Brown writes in 'Eagles', releases the parent snake eagles (African — *Circaetus*) from close attendance at the nest.

It is after the eaglet is almost two weeks of age and by itself for long periods in the nest that it is most delightful to observe. When it is not sleeping, the eaglet spends its time stamping about in the nest or yawning, pulling at the sticks of the nest or attempting to swallow any unconsumed food prey. It nods its head and looks over the rim of the nest for a short while only to fall asleep and wake up soon after, frequently uttering its cheep, cheep calls with an intermittent cluk...... cluk.......

The eaglet grows visibly restless after a long wait all alone in the nest. Most of the feeds observed were in the afternoons and it is after mid-day that the eaglet turns much more restless. Frequently the anticipatory and attentive look of the eaglet gives an indication of the parents impending visit. Once it is hungry, the eaglet starts calling and its calls at this age resemble in less volume the calls of the adult *melanotis.* It was often noticed that the eaglet's calls were answered by the adults and after an exchange of calls for a few minutes, an adult sometimes arrived even with food. The eaglet when still young was fed small morsels but when over two weeks old it attempted to swallow a small snake neck first. Small snakes were the only prey that we observed the over two week old *Spilornis* eaglet swallow by itself. The other prey *viz.*, Lizards, frogs, mammals etc., were first torn by the adult birds and then tiny morsels of flesh and meat were very gently and delicately fed to the eaglet.

Cleanliness is strictly maintained at the nest. Like all raptors, the eaglet of *Spilornis cheela* too stands up, moves backwards and positions its rump towards the edge of the nest. It then aims high above the level of the nest rim with its rump directed upwards and its head crouched and bent inwards towards the bottom of the nest. Once in this rather awkward looking position, the eaglet ejects its faeces well clear over the side of the nest. Most of the droppings fall onto the forest floor below but several leafy branches get a fair sprinkling of whitewash too. Similar behaviour of ejection of droppings from the nest has also been observed in *Accipiter badius.*

Extended duration in the hide, observing the eaglet alone in the nest for several hours continuously never gets boring, whether it is sleeping, yawning or just clowning. More often than not, the eaglet pays little attention to the great number of other forest birds that so commonly move about around the *Spilornis cheela* nest, often almost settling on the nest itself.

We once noticed sixteen species of birds in the space of three hours at and around the *Spilornis cheela* nest. Most of these were small birds, jungle mynas, bulbuls, warblers, flycatchers, sunbirds. At the nest, a fully fledged eaglet was observed to sit tightly so that the nest appeared empty. This is usually done when intruders are in close proximity to the nest. When danger threatens the fully grown eaglet's main defence is to sit tightly so as to become almost invisible. At this particular nest I (RKN) thought the nest empty till the adults' vocalising galvanised the eaglet into action. It was on 20th July, 1982 that the fully fledged eaglet left its nest. In the afternoon, the eaglet was perched on a branch near the nest, and was calling "Kee... Kee... Ke" with an occasional "cluk.... cluk". The fledgling would frequently flap its wings and seemed excited. None of the adult birds seemed to be around though on careful searching by Bhanga, one of the adults was spotted on a perch nearby with its beak open and looking very alert. After some time the adult eagle called characteristically and the eaglet dropped onto one of the disused machan poles. The adult circled overhead calling frequently and suddenly swooped down and alighted on the nest, calling frequently and was then joined by the juvenile. Surprisingly, the adult eagle pecked furiously at the juvenile; probably to lessen the eaglet's dependence on the nest. Soon after, the parent flew into the valley below, calling agitatedly. The eaglet remained near the nest and a short while later another adult arrived which was probably the male. This adult perched some thirty feet from the nest, calling infrequently. The eaglet flew towards this adult and was not repulsed. Both remained together on the branch for about ten minutes till it started raining. The eaglet then made the first move and flew into the valley and perched on a small tree. Though still under the adult's watchful surveillance the eaglet, now enjoying its newly found freedom, flew again and perched nearer the nest tree. A flock of blossomheaded parakeets now settled noisily on the upper branches of that very tree. The eaglet stared at the parakeets in bewilderment, emitting occasional "cluck.... cluck", calls reminiscent of a hen's. The parakeets soon departed and the eaglet flew over the trees to a forest clearing opposite the valley. It was observed to settle on a teak tree and this was its longest flight yet observed. An adult eagle was also seen flying nearby as though keeping a watchful eye on the eaglet. The eaglet then took another long flight and was soon out of sight.

PLUMAGE OF FLEDGLING

Upperparts: Brown throughout, somewhat lighter and paler than the adult. Whitish and paler edges of feathers showing through on the dark upperparts, thereby giving a white spotted appearance. Crest erect and appeared better formed and much more prominent than that of the adults, being dirty white overall with the tips blackish and brown. Crest was easily noticeable even when the eaglet was in flight.

Underparts: rather dark. The lower plumage unusually dark brown with whitish, streaks and spots throughout. Chin and throat much paler, almost dirty white.

Tail: distinctly lighter than the adults and multi-banded with 3-4 dark bands and an equal number of paler bands.

Underside of wings with more white and pale cream and somewhat more barring.

Whitish bars on wings and tail more numerous in juveniles than in adults (Blanford & Dates, Old Fauna, Vol. 3, p. 359).

For making the last observation the nest site was visited during the late afternoon on 21st June 1982. An eagle call was heard but inspite of a proper search the eagles and juvenile could not be located. The monsoon vegetation was very thick and this made spotting all the more difficult. The eaglet of *Spilornis cheela* had thus remained in and around the nest for approximately 2 months.

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I (RKN) would particularly like to mention and thank my father, Mr. Kekoo Naoroji, and my uncle, Mr. Naval P. Godrej, for taking an interest in the project and funding the whole trip. I am indeed indebted to them and to the whole family for their understanding and co-operation.

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NOTES ON FEEDING BEHAVIOUR OF *VARANUS BENGALENSIS* (SAURIA: VARANIDAE)[1]

WALTER AUFFENBERG[2]

(*With seven text-figures*)

The present study documents certain behavioural aspects of the feeding of *Varanus bengalensis*. Search patterns are emphasized, showing that this species exhibits both area- and object-concentrated foraging behaviour. Most successful area-concentrated foraging includes casting behaviour. The perceptual field is estimated, with mean reactive distance shown to be 1.3 m, and mean active pursuit distance 2.6 m. Flush-pursuit foraging behaviours are most common, with success ratios varying from 44 to 82 per cent, depending largely on prey type. Social facilitation is an important aspect of high predator densities, with piracy common, but with success dependent on size of the interacting individuals. The most common hunting modes are speculative, flushing, and open pursuit; stalking is rare.

INTRODUCTION

A number of studies have demonstrated the importance of sensory modalities in predatory behaviour of reptiles (*see* Burghardt 1970, Herzog and Burghardt 1974, for pertinent reviews). Most students now realize that prey movement, colour, morphology, and predator experience are all relevant variables in prey selection (Ruggiero *et al.* 1979). However, few studies have analyzed the movements associated with predation by reptiles, as has been done with many species of fishes, birds, and mammals (*see* Curio 1976, for review). For the most part studies of reptile predation behaviour have been experimental and have focussed on aspects of chemoreception in prey capture (chiefly reviewed by Burghardt 1975, Burghardt and Pruitt 1975), focussing on the nature and role of innate chemical recognition of prey and the effects of experience.

Description of predation in reptiles are largely limited to isolated field reports and cursory observation (*see* Drummond 1979, for a notable exception), and almost all of them deal with snakes. Clearly, an understanding of the sensory and behavioural adaptations of predatory lizards demand more comprehensive and detailed descriptions than are presently available. The research reported here was an investigation of the ethology of the predation of the large varanid lizard *Varanus bengalensis* under captive conditions.

MATERIALS AND METHODS

Twelve adult *Varanus bengalensis* were used as the basis of this study; two males and eight females (Av. total lengths during the study for males was 115 cm, for females 95 cm). All were long time captives, raised from hatchlings, thoroughly accustomed to conditions of captivity. All were kept in two greenhouses (156 m^2) at the author's home in Gainesville, Florida. Each greenhouse contained five individuals (4 females, 1 male). While the females

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had been kept in specific greenhouses for several years, the males were often interchanged during spring to encourage reproductive behaviour, which was being studied at the same time (*see* Auffenberg 1981a, b). Each greenhouse was a seminatural situation, being provided with facilities for climbing, basking, and hiding. While most of the central floor area was clear, small rock and brush piles were located around the edges; a few plants and a log or two were near the center.

The data on which the study is based were gathered by videotape recording. One (sometimes two) video cameras (Panasonic WV-1300A) and time lapse recorders (NV-8030) taped the monitors' activity every day from 0800 to 1730 hrs for a period of three years. These tapes form the basis the present study as well as of the analyses already finished (Auffenberg, 1981a, b, on combat and courtship). As a result, aspects of the feeding behaviour of this species were recorded during a total of 250 feeding bouts. The completed tapes were scanned every evening by means of a fast playback feature and appropriate sections marked for later analysis.

On later review of pertinent tape sections, movements over the surface, as well as movements of parts of each monitor during food searches (head, tongue, front feet, etc.), could be traced off of the video screen (Panasonic TR-9001M) and direction, angles or rates of movement analyzed.

Four types of food were offered during the study — "carrion," turtle eggs, live white mice, and live frogs (*Rana utricularia*). The "carrion" was represented by pieces of dead laboratory rats; frozen and then cut into 16-20 pieces. Table 1 provides pertinent data on the physical characteristics of the prey.

Food was offered every two weeks during the warmer months, every four weeks in winter. Carrion was usually randomly scattered about the greenhouse floors, turtle eggs randomly placed on the surface or buried with the top of shell 2 cm deep; live frogs and mice were thrown into the greenhouses in places where the monitors could not see them hit the surface. These methods of food presentation tended to generate strong, consistent search behaviours on the part of the resident monitors.

RESULTS

FOOD CONSUMPTION

Satiation Level.—Satiation level was determined on the basis of the monitors nudging the food with their snouts instead of eating it. For the adult males the mean total food weight at satiation level is 160.7 g ± 24.8 g; for females 99.8 g ± 15.7 g. These results are respectively 6.9 per cent of the mean body weight of the males (g) and 5.8 per cent of the mean body weight of the females (g). However, variability in total intake is great, being from 68.4 to 495.9 g for males (to 18.1% of total body weight). There is no correlation between amount eaten and food type.

Handling Time.—This period includes both manipulating the food (including killing it, if necessary) and swallowing. Both are clearly

TABLE 1

PHYSICAL CHARACTERISTICS OF THE PREY OFFERED TO *Varanus bengalensis*

Prey Type	n	X weight (gm) + PE	X silhouette size (cm²)
"carrion" (rat chunks)	38	17.1	10.5
turtle eggs	12	18.6	5.1
frogs	23	13.1	14.8
mice	27	26.7	16.2

positively related to food particle size. However, in the present study, the "carrion," live frogs, and live mice were all approximately the same size (Table 1).

Table 2 shows that mean handling time is least for "carrion," intermediate for live frogs, and very significantly more for live mice. On the basis of comparative review of the taped sequences, it is obvious that the increased handling time for live mice is largely due to the fact that frogs are often swallowed alive, with little or no attempt made to stun or kill them. On the other hand, live mice are quickly, but repeatedly dashed and/or scraped against the ground after being grasped. Unpublished data on feeding of adolescents of this monitor species (Ganci and Auffenberg MS) suggest that killing techniques are suited to prey size and the extent to which the prey can possibly injure the attacking individual.

TABLE 2

HANDLING TIMES (SEC) OF VARIOUS FOOD TYPES

Food Type	n	O.R.	X	PE±	S.D.	t-test
"carrion"	129	0.6-20.4	3.7	1.8	5.0	not sig.
live frogs	112	0.9-14.4	5.2	0.9	1.1	highly sig. (df = 87,
live mice	88	6.9-28.8	16.3	3.1	2.4	t-test=3.17

Other Foods.--Several other prey taken, but not specifically offered as food, were noted and are worthy of mention. Ants were often eaten, but only a large species of carpenter ant (*Camponotus* sp.). These were obtained either when the monitors "rooted" through dry leaf litter with their snouts, or when the ants were moving in the open. In either case, these ants were usually picked up individually with the *tongue*, less often grasped by the jaws.

Three native lizards frequented the greenhouses: *Leilopisma laterale, Eumeces inexpectatus,* and *Anolis carolinensis.* All three species were eaten, though not commonly, for some individuals of particularly the last species remained in the greenhouses for several weeks and their remains were rare in the monitor droppings. Two successful attacks on *Anolis carolinensis* were observed; both after active pursuit on the ground. No attacks on *Eumeces* were witnessed, but their remains were sometimes found in monitor droppings.

Leilopisma were often taken, usually by a short pursuit and grab after having been flushed from surface debris by the rooting monitors.

Eggs of *Varanus bengalensis* were regularly eaten by the males (only), either when the eggs were strewn on the surface or placed in natural nests by the females. Young hatched naturally in the greenhouses were also sometimes eaten by adult males (only?). The largest *V. bengalensis* cannabalized was a female with a total length of 46 cm, by a male 121 cm total length.

Earthworms and beetle larvae were regularly eaten usually when digging next to rocks, logs, or in other damp places.

HUNTING MODES

Four major hunting modes were identified: random foraging, speculative foraging, stalking, and open pursuit. The first is discussed in detail below. Speculative foraging is not random, but an area-concentrated search pattern (see below). It included *digging* in the soil or debris with the front feet, *"rooting"* through surface litter with the snout, and *flushing* by walking over or tonguing a small area. Speculative foraging in areas expected to produce prey was a common hunting mode. Most commonly it took the form of digging under and next to logs and rocks, or in the dampened soil under small leaks in the roof. Prey secured this way were earthworms and beetle larvae. For unexplained reasons, females dug more commonly than males (93.8% of 66 digging bouts were by the females). Even when a correction is made for the larger number of females, digging was largely a female activity (78.7% of all digging bouts). It may be related to nest selection, but there is no evidence for this.

Rooting was an activity equally practiced by both sexes. It consists of both lateral and anterior movements of the snout, moving the litter about in rather rapid, jerky movements. The behaviour may be related to the slit-like, posteriorly located nostrils in many *Varanus* species. Rooting results in the capture of earthworms, ants, lizards, and particularly beetle larvae. The latter is the predominant prey category of this lizard species in the wild (Auffenberg and Ipe 1983) and most are probably captured this way.

Flushing includes behavioural patterns in which a hidden prey is made to move. This was accomplished by scratching with one front foot, touching with the tongue, walking over the area quickly, and rarely during digging and rooting. It is a very effective hunting mode and may be speculative, or follow a pursuit sequence when the prey is momentarily lost to view. When the importance of flushing and distant visual recognition are compared in successful foraging bouts, only 35.0% of the total successful captures of frogs and mice were accomplished by flushing the prey from a hiding place; 65.0% were visually spotted. For frogs, only 37.5% were flushed, 62.5% were caught after the frogs themselves moved. For live mice, the same ratio was 21.2% to 77.8%. Though the difference is significant at the 0.5% level, the reasons are not apparent.

Stalking of prey was very rare. When prey was seen, the attack was mounted from the detection distance, with no apparent attempt to shorten attack distance via a stealthy approach. Stalking by following a scent *trail*, particularly after flushing, probably occurs, though I found no evidence for it in this analysis.

Open pursuit was the most common hunting mode immediately preceding prey capture. Several important factors relating to open pursuit of both live frogs and mice were analyzed. These are: reactive distance and direction, chase distance, predation pursuit speed, prey speed (frogs and mice), and prey capture success ratio (Table 3). There are no significant differences in the successful pursuit of frogs compared to mice, or the mean visual reactive distance for each of these prey, or the mean chase distance for each prey species. However, prey escape speed is very different for the two prey species. The similarity of chase distances is due to the fact that the monitors grasp frogs anywhere on the body during their pursuit, but mice are almost always grasped on the side, resulting in the predator having to spend more time during the chase to get its head in an appropriate attack position. Frogs were attacked in mid-air during a jump, or immediately after stopping, when they frequently "froze." Freezing behaviour is clearly advantageous to frogs, for the attack success ratio on continuously moving frogs was 59%, while for those that freeze the ratio was 33%. Gregory (1979) considered immobility an im-

Table 3

Factors related to the open pursuit hunting mode for live frogs and mice*

Prey	X Visual Reactive Distance (m)	X Chase Distance (m)	Prey Speed m/sec		X Prey Diameter (mm)	Success (%)
			Normal	Escape		
Frogs		0.3±1.13	0.57	0.82	14	49
———	1.34±0.41					
Mice		2.6±2.15	0.004	0.12		51

* Prey density consistently 1/52 m²; frog n=112, mice n=88.

portant predator avoidance behaviour by *Rana aurora* and showed that distances to which potential predators can approach the frogs are positively correlated with predator size, while Heatwole (1968) proved that allowable predator approach distances are related to degree of cryptic coloration in anoline lizards. In this study, the majority of frogs remained completely immobile (81%) m until actually touched by the snout or tongue of the *Varanus bengalensis.* The frogs flushed by *Varanus bengalensis* are chased again, apparently on the basis of visual, rather than olfactory recognition.

When caught, the frogs were usually scraped against the substrate a few times to move them into position for swallowing. Though no testable data are available, male *V. bengalensis* seem to have chased their prey at a higher rate of speed and appeared somewhat more motivated to capture them than females (see Auffenberg 1979, for other intersexual differences in the feeding of this species).

In contrast to frogs, more mice were captured when they froze (capture success for all moving mice 44%, for all frozen mice 82%), suggesting that scent probably plays a greater role in location of frozen mice than frozen frogs.

Mice were also grasped very specifically, almost always on their side. They were then violently shaken, bitten repeatedly, and scraped and hit on the substrate. These observations were consistent with those of Loop (1974), who studied the attack and ingestion behaviours of *V. bengalensis* in considerable detail. Similar attack and ingestive behaviours depend on size of predatory snakes (Loop and Bailey 1972). Live mice often bit the predator on the side of the head, particularly on the area of the ascending maxillary process.

Mean reactive distances for mice in which the tongue was used to locate prey was 0.06 m ± 0.26 (n = 31). This distance is only slightly more than the length of the tongue itself and suggests that scent is important in locating prey only at close range. Gettkandt (1931). Kahmann (1932), Burghardt (1964, 1966), Herzog, and Burghardt (1974) all showed that prey movement was most important in eliciting attacks by snake predators and the same pattern seems operative in *Varanus bengalensis.* Figure 1 shows the average visual- and scent-reactive distances calculated in this species during the study. In addition, it illustrates the positions of prey resulting in pursuit. None of the pursued prey were located in the area included within 60 degrees on either side of the midline and behind the head. Thus the visual angle

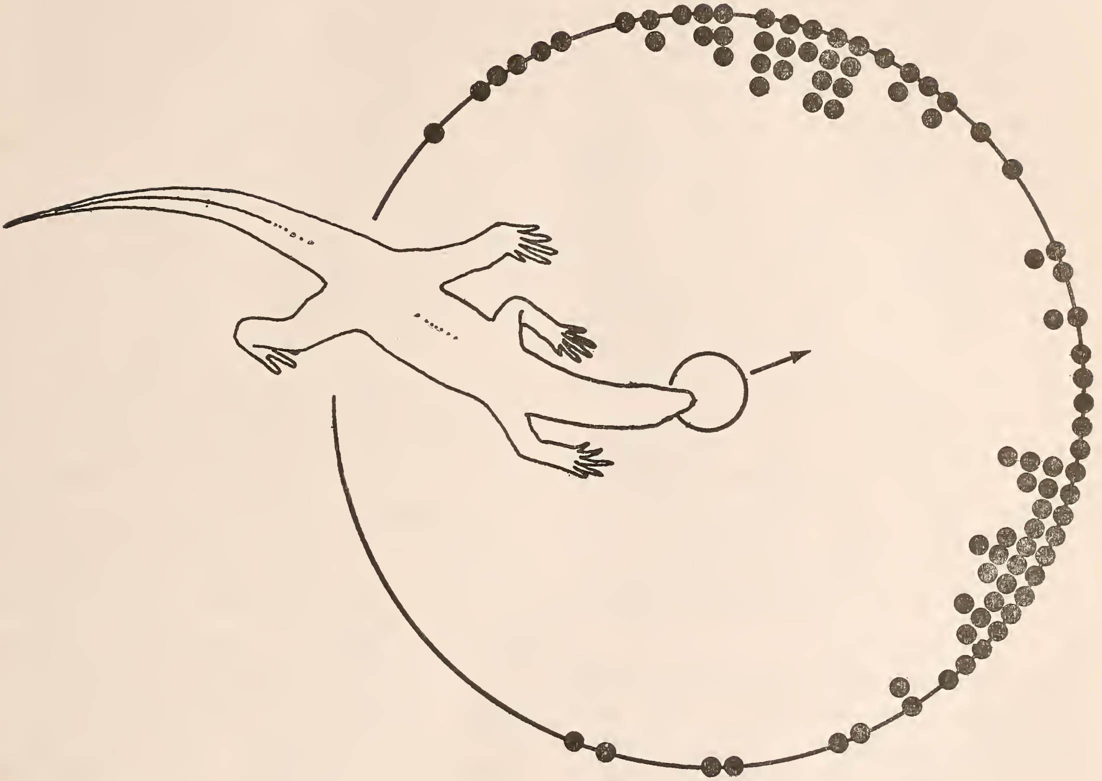

Fig. 1. Mean visual (outer circle) and scent (inner circle) reactance distances to prey in *Varanus bengalensis* (X = 1.34 and 0.12 m respectively). The dots show the positions of those prey noticed and chased (n = 88) by the monitor in relation to the direction of travel (arrow).

important in foraging *V. bengalensis* is probably about 240°, or 120° on each side of the midline anterolaterally. The majority of reactances occurred with prey located within an arc of about 90° on each side, with most between about 30° and 80°.

SEARCH BEHAVIOUR AND FORAGING TACTICS

Social Facilitation.—The sight of one individual feeding often induced other nearby individuals to start feeding on their own, or in a common feeding area. The behaviour is well documented in various fish, bird, and mammal species (*see* Curio 1976, for review), but has been only occasionally reported in reptiles (Greenberg 1977 Auffenberg 1981c). In monitor lizards it is common in particularly those species feeding in aggregations at large carrion, such as *Varanus komodoensis* (Auffenberg 1981c). In the *Varanus bengalensis* used in this study social facilitation often took the form of piracy, a form of which has previously been studied in birds (Hatch 1970).

Piracy among *Varanus bengalensis* normally occurred when one individual had prey in its mouth. Analyses of piracy observed in this study (n=45) show that, in general, it was an unsuccessful tactic (success percentage 26.7). However, success level was largely determined by the sizes of the interacting individuals. Thus piracy acts against smaller individuals by larger ones was frequently successful (62.5% of all such interactions). However, most piracy attempts were conducted by smaller (n=33) than by larger individuals (n=12), though usually unsuccessful (n=33, 84.8% failures), regardless of the victim's size; and even less successful when the victims were larger than the pirates (n=23, 87.0%). Attempted piracy among more or less equal-sized individuals was usually unsuccessful (n=14, 28.6%).

Food particle size was also clearly important, for when the food particle diameter was larger than 14 mm and length greater than 50 mm, pirating attempts were more successful (n=13, 81.0%) than when food particles were smaller (n=20, 19.0%) and handling time was short.

Piracy attempts were not particularly rewarding when food was plentiful, for other individuals were often drawn to the area of piracy attempt, and these individuals may feed on the surplus food, while the potential (usually unsuccessful) pirate is chasing another. Piracy attempts were also characterized by a chase and/or grab at the mouth—sometimes even when the other mouth had nothing in it. It was also more common by certain individuals than by others of equal size.

Search Movements. — Locomotion during which there is no search for food was noticeably different than that while looking for food. The primary differences during food search were (1) more rapid and regular tongue flicking, and (2) greater lateral head and body movements. Nonforaging locomotion was usually practiced when individuals moved between the retreat and basking sites. These trackways were usually direct, with few and generally small deviations; mean forward speed was 9.0 cm/sec. On the other hand, trackways made by foraging individuals were less direct, often convoluted, circular or sinuous (Fig. 3). Mean forward speed was the same (8.1 cm/sec). The head is rhythmically swung from one side to the other (=scanning), with tongue-flicking usually occurring at the end of each lateral

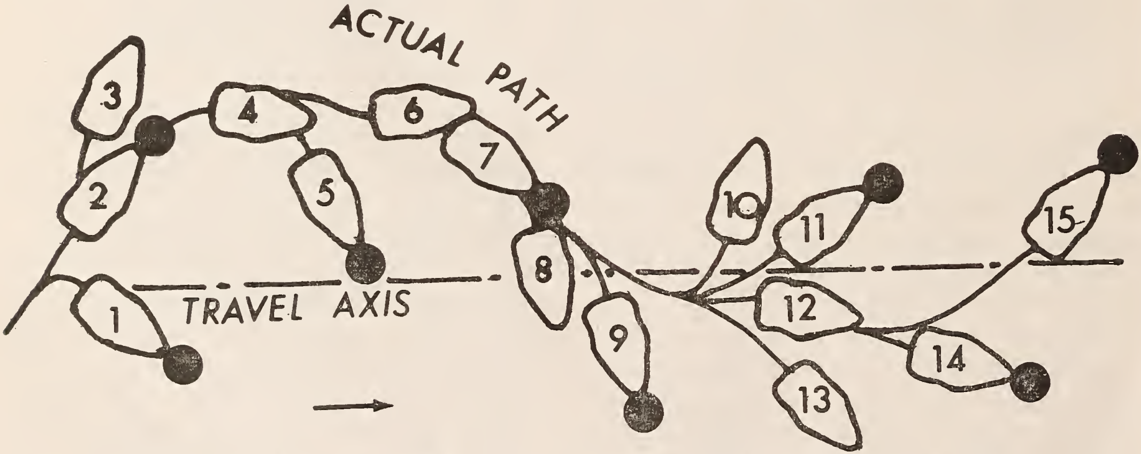

Fig. 2. Typical scanning movements during foraging. Numbered heads show positions at one-second intervals; dots show points at which tongues have been flicked; travel axis and actual path both indicated.

swing (Fig. 2). A special form of scanning in small areas is called casting (see Curio 1976, for discussion of its use in invertebrates). In casting the forward movement is stopped entirely (or nearly so), with exaggerated lateral head sweeps and (in varanids) with more tongue flicks (Table 4). Tongue flicks in non-foraging movements usually occur at the

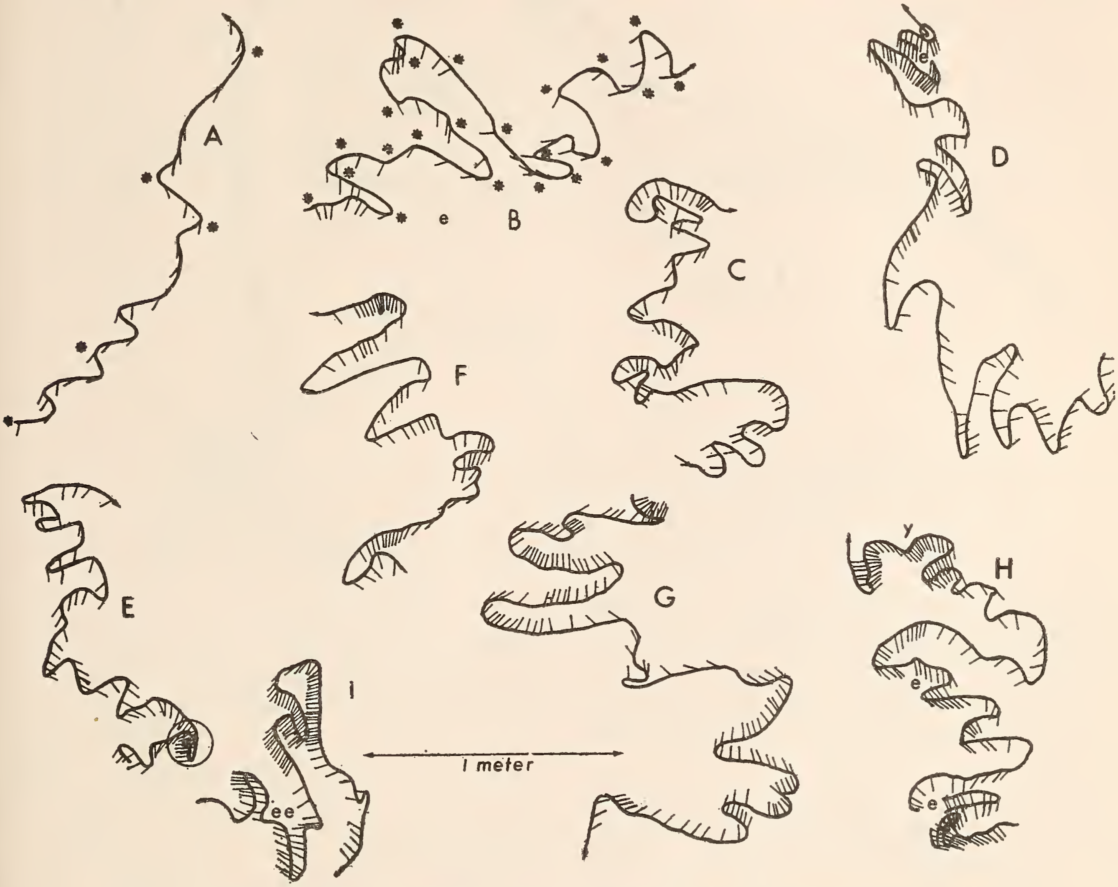

Fig. 3. Typical locomotor patterns. Scale indicated. Head positions shown as short lines, with continuous line tracing movement of snout tip; arrow showing direction of body movement. Dots indicate tongue flick locations; X shows food locations (see text). A, non-foraging pattern, without scanning; B, foraging pattern with typical increasing tonguing during wide lateral scanning movements, e, to right to trail being position of buried turtle egg (not found), non-area-concentrated pattern; C, same, but foraging more intense as seen in slower movements and rate of forward progression; D, same, but with more intensive, slower search near buried turtle egg (e, located and eaten); E, same, near wet spot on greenhouse floor (circle); F, alternating low and high intensity area-concentration pattern; G, same, more intense with slower greater lateral movement; H, pattern in which two buried turtle eggs (e) are found and eaten, and place where egg found by same individual the day before (y); (I) pattern preceding and following successful location of two pieces of meat (ee).

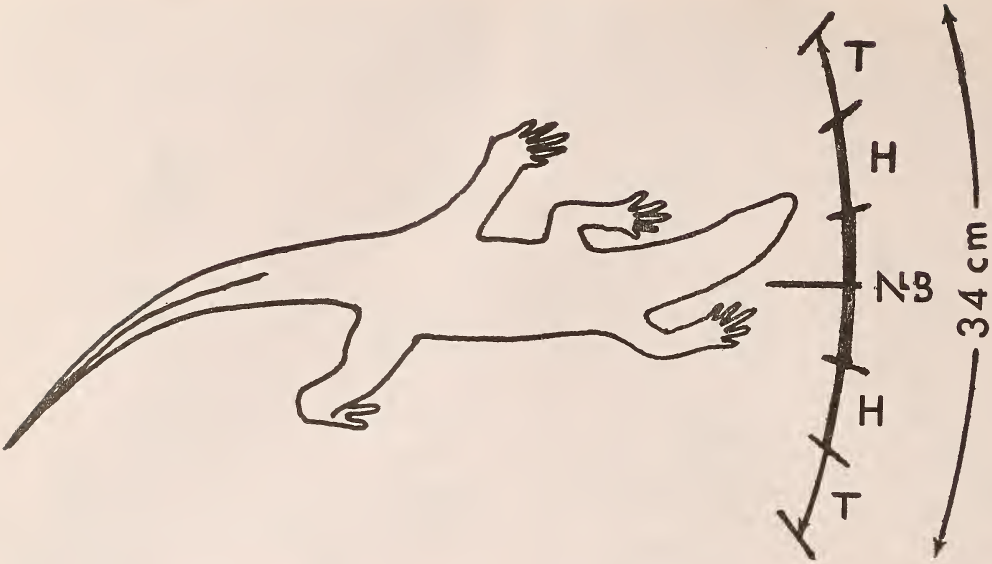

Fig. 4. Components comprising the maximum food search path of *Varanus bengalensis*: NB = maximum lateral undulations of neck and body (*c.* 7 cm on either side of travel axis), H = lateral movements of head, *c.* 5 cm, T = lateral movements of head, *c.* 5 cm. Total width of scent discrimination path about 34 cm.

greatest extent of the head swings (sometimes during the mid-swing distance) (Fig. 3A). During foraging the tongue flicks occur more rapidly (Table 4), usually at several places between the greatest lateral movements of the head (Fig. 3B).

The lateral head scanning movements are functionally increased by the tongue length, for it is usually completely extended with each flick (max. distance about 5 cm in adults). In addition, the amplitude of the lateral movement of the body is 5-10 cm (Av. = 7.3); the "wave length" of the lateral head swings is one per 10-80.3 cm, depending largely on lizard length (Av. = 63.2 cm). Figure 4 illustrates the extent of the major movements contributing to the total width of the search path in *Varanus bengalensis* adults. The mean head movement per second in casting is about 40% slower than that when scanning, and 69% slower than when not foraging (Table 4). Thus both head movement and forward progression is slowed down as foraging intensity is in-

Table 4

Comparison of movement patterns during the search for food and otherwise

		Foraging (n=28)	
	Nonforaging (n=31)	Scanning (n=12)	Casting (n=16)
X Forward Speed (cm/sec)	9.0	8.1	0.2
X Lateral Head Sweep (total side-side) (in cm)	8.0	10.2	25.6
Distance of Head Movement/sec (in cm)	1.1	0.6	0.3
X No. Tongue Flick/sec	7.2	3.8	2.3

creased, and tonguing becomes more rapid. Casting movements are slower and with a greater lateral component than other patterns (Table 4).

Area-concentrated Search Patterns.—Varanus bengalensis shows typical area-concentrated search behaviour, especially in reference to casting search patterns. Area-concentrated patterns using casting techniques typically alternate with scanning patterns during the search for food. Figure 3 provides typical examples (Fig. 3D-I). A comparison of the non area-concentrated search pattern of Figure 3B, with area-concentrated types seen in parts of particularly patterns D through I clearly shows the slower movements and more complete investigation of the surface in the area-concentrated types. The scent of buried turtle eggs leads to area-concentration by casting, each at places where a buried egg was found the day before

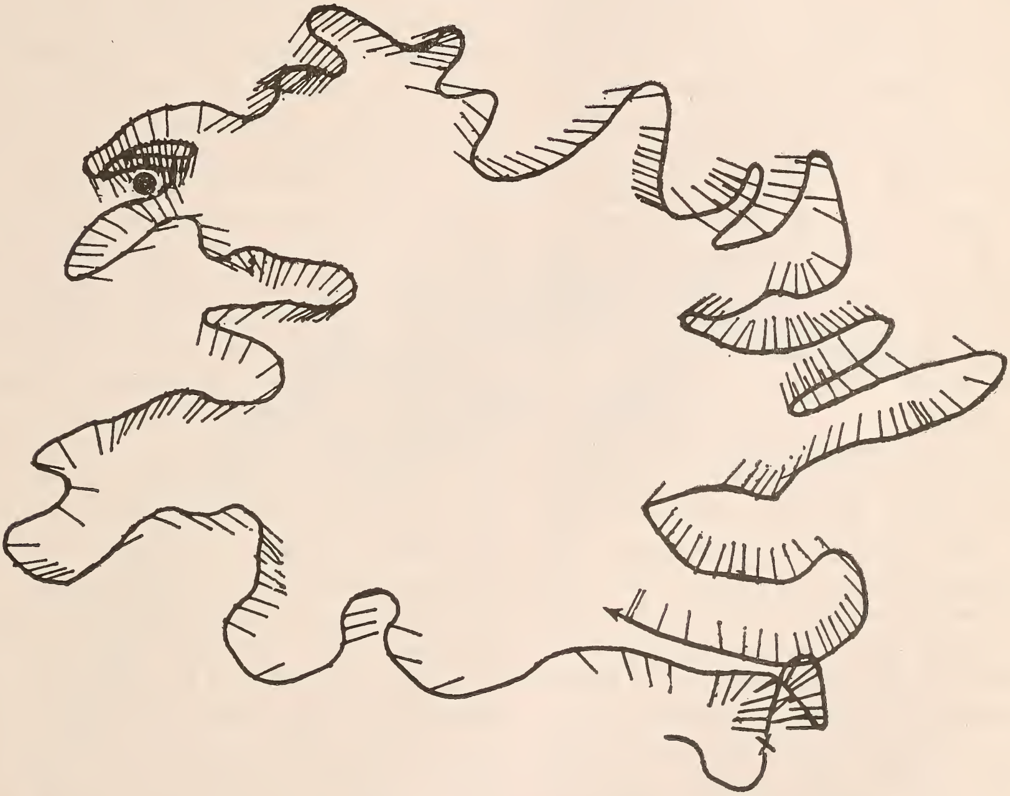

Fig. 5. Example of an extensive area-concentrated search brought in an area (dot) where a live mouse had been captured 24 hours previously, then returning by way of a rather circular path to the spot (X) where another live mouse had been captured at the beginning of the sequence shown. Maximum diameter of search path shown 2.1 m, total elapsed time 321 sec.

(Fig. 3H). Such area-concentrated searching as evidenced by casting clearly begins some distance (10-80 cm) before the food site (distance undoubtedly related to olfacient strength). Note that in Figure 3B a foraging monitor failed to find and eat a buried turtle egg at E, though it came within 30 cm of the location on two scanning sweeps; the travel rate and direction, as well as the tonguing frequency, all suggest it did not detect the food.

Figure 5 also shows another feature of the area-concentrated foraging pattern—that the successful location of food is not only preceded by, but also usually succeeded by casting. Direction changes after food discovery are not significantly different than changes before food detection, unlike the hunting behaviour reported in some birds (Smith and Dawkins 1971). However, the arc produced in casting has a mean radius of 1.2 m before discovery, a radius of 0.7 m after discovery, with a proportionately smaller variance. Scanning movements are greater near a scent focal point (X scanning width 28 cm) than they are when the monitor is far from the focal scent area (X = 15 cm).

Intense area-concentrated search patterns occur when adult males respond to crossing the track of a female. The major difference in this pattern and that of a generalized, non-concentrated pattern, such as Figure 3B, is the former's more convoluted path and the alternation between more rapid and less rapid head movements as the pattern shifts from high to low intensity area-concentrated search patterns.

Figure 5 shows the resulting area-concentrated search pattern when food is repeatedly located in fairly small area. Even without repeated food discovery in one area, there is a tendency for *Varanus bengalensis* to spend more time in places where it found food earlier the same day, or even on previous days. As an example, in a sample of nine food search bouts randomly selected from the tape (total 6 hrs, or 21,776 sec, Av. bout length 40.3 min., or 2419 sec), individuals spent an average of 31.6% of the total search time at places where they had found food earlier in the same bout. This entire time was spent casting over the discovery area, with frequent tonguing of the soil and leaf litter (5.4% of the time was spent at food sites during earlier bouts; 3.3% of the time was devoted to activities unrelated to food discovery; 59.7% of the time was spent in areas where no food had previously been found). Statistics important in analyses of the situation are: each greenhouse floor has an area of 7 m x 7 m (49 m²), marked in square metre squares, in which food was offered and behaviours of the monitors taped. Nine feeding bouts were photographed, providing a maximum possible surface for movement of 441 m². But of these only 181 m² were visited (41.0% of total), probably due to the fact that carrion food particles were located on only 30 squares (6.8% of total area available). The difference between the visitation of 181 and 30 (difference = 151 squares) is due to both random food search and movement from one food source to another. The 30 squares provided with food at one time or another were visited 105 times, including 75 revisited a second (or more) time, and only 8 never revisited again. Of the squares traversed (310) that never had only food (280), 82 were revisited a second (or more) time, and 77 were never revisited after the final crossing. This more or less equal distribution regarding non-food square transverses suggests these movements are random. However, the high order of revisits to squares in which food was found earlier (that same bout, or a subsequent one) suggests a very significant non-random site-specific pattern related to

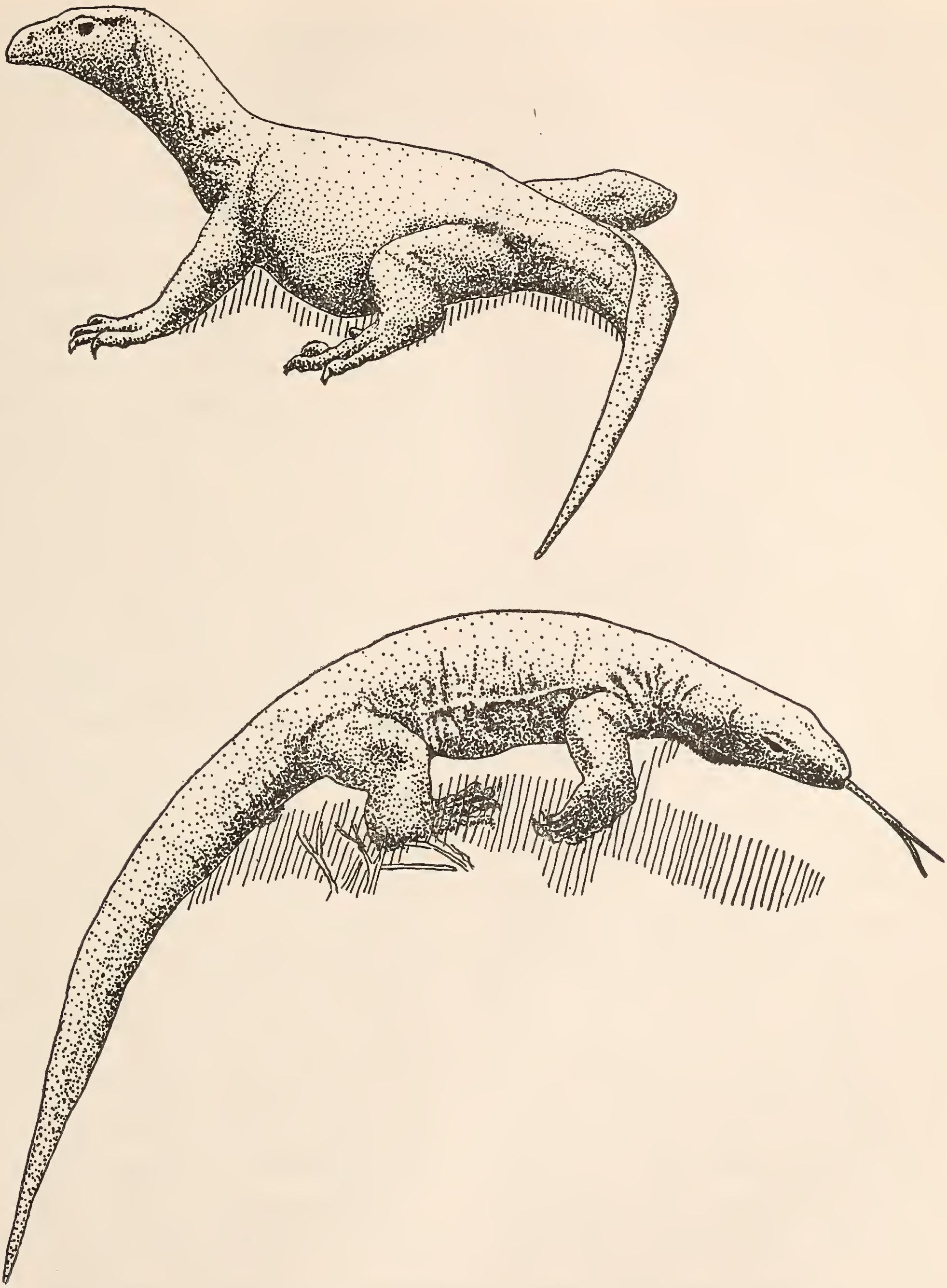

Fig. 6. *Varanus bengalensis; above,* attentive posture when engaged in an object-concentrated (entirely? visual) search for jumping frogs; *below,* normal body position during an area-concentration (largely olfactory) search for buried turtle eggs.

previous successful food location (X^2 34.46, df = 1, $P = 0.001$).

Object-concentrated Search Patterns — In many circumstances it is difficult to distinguish between area- and object-concentrated search patterns, especially when the search for food is obviously largely scent-dominated. One example is when the intensive search for an object (female, buried turtle eggs, etc.) takes place in a small area. Digging next to and under logs and rooting in leaf debris for insect prey are other examples. However, in other circumstances concentration on a particular object is clearly divorced from concentration on a place. This perhaps is best illustrated in the quite different search for larger active prey, such as living frogs and mice.

During the search for moving prey the tongue is rarely used. The head is held high, though parallel to the ground (Fig. 6). The entire demeanour appears tense and alert, with the head often turned quickly from side to side. Likely movements within several metres lead to a rapid dash in that direction, and the prey is often chased for some distance. Loss of visual contact through freezing or hiding behaviour of the prey usually leads to intense area-concentration behaviour with tonguing and rooting of the surface litter in a small area until the prey is flushed or found. Neither time budget nor space utilization analyses during object-concentrated searches show any significant positive relationship with previous successful capture sites—at least within the confines of the greenhouses used in this study. However, field investigations would undoubtedly show that object-concentrated hunting modes lead to selection of specific habitat types and probably at specific times of the day, as they do in *Varanus komodoensis* (Auffenberg 1978, 1981c). Though no comparable studies have been conducted on reptiles, research on other vertebrates (i.e., birds and mammals) has shown that specific hunting behaviours are affected as a consequence of remarkable few experiences by the predator (Crose 1970, Randall 1970).

Discussion

One of the results of this study is that the satiation level has been shown to be much higher for adult males than for adult females, agreeing with earlier data that during adolescent growth the males of this species tend to consume more food than females of the same age class (Auffenberg 1979). This suggests that males may process food faster than females and thus help to explain why males tend to bask longer than females (Auffenberg 1979). The fact that male *V. bengalensis* eat more food per unit time than females suggests that males are exposed to higher predation levels by larger carnivores, and thus the faster growth of males probably results in a differential mortality in the sexes. This should be checked by appropriately designed data obtained from field studies.

Handling time is significantly lower for carrion type food than live prey; particularly those prey species, such as mice, that are capable of injuring the predator. These and other data clearly show that attack techniques are suited to prey type, as has been shown to be the case in the Komodo monitor (Auffenberg 1981c). Unpublished data on captive adolescent *V. bengalensis* suggest that these techniques are developed quickly and very early, requiring a remarkably short time for development (Ganci and Auffenberg, MS).

Foraging behaviour of this species includes a great amount of rooting in the surface litter. The way in which this is done plus the similar behaviour of other slit-nostriled varanids (*Varanus rudicollis, V. grayi, V. dumerilii*) and apparent absence of such behaviour in the round-nostriled forms with which I am familiar (*Varanus komodoensis, V. varius, V. salvator*; all in author's field notes) suggests there is an important functional relationship requiring additional confirmation.

The ambush tactic is apparently not used by *Varanus bengalensis* of any size to obtain prey. However, in *V. komodoensis,* the adults regularly practice this technique, while the young or even half-grown individuals do not (Auffenberg 1981c). I conclude that ambush hunting is a behavioural pattern only regularly practiced by very large monitors hunting proportionately large prey. It may, in fact, be restricted to only adult *V. komodoensis* as a regular hunting tactic among at least varanids.

On the other hand, open pursuit of prey much smaller than their own mass is a common behavioural mode in *Varanus bengalensis,* as it seems to be in most (all?) other monitor species, including all sizes of *V. komodoensis.* Open pursuit often follows a deliberate object-oriented search pattern—frequently initiated by visual prey recognition from a distance. Similar hunting modes have been reported for varanids in the field (Auffenberg 1981c), and we must conclude it is one of the most important techniques for food procurement by at least the more active species of the family (there is no evidence that it occurs in *Varanus grayi,* as an example, author's field notes).

Area-concentrated search patterns are also important, particularly for small, inactive live prey (beetle grubs, etc.) and carrion. In this mode, scent apparently plays a major role in food location. It may be accompanied by rooting, digging, scratching, and similar surface disturbance techniques designed to flush or disclose the prey. Tonguing is frequent and casting behaviours are characteristic during high intensity search for particularly carrion. The ability of varanids to locate carrion from great distances (*c* 10 km) has been reported in *Varanus komodoensis* (Auffenberg 1981c) and from lesser distances in *Varanus salvator* (Auffenberg 1980). Though *V. bengalensis* apparently feeds on less carrion in the wild than do these two species (Auffenberg, in press), scent-oriented, area-concentrated patterns are utilized in its location. Furthermore, the present study makes it clear that individuals frequently return to area in which they have found food previously. The same pattern has been demonstrated for *Varanus komodoensis* in respect to ambush locations for large prey (Auffenberg 1978, 1981c). Long-lived lizards, such as *V. bengalensis,* would clearly profit from long-term area-concentrated search patterns, for longevity provides the accumulation of experience necessary to concentrate their feeding forays in those areas where prey are either actually more abundant, or attack is facilitated by peculiarities of prey behaviour or local topography. This is clearly demonstrated in the behavioural relationship of adult *V. komodoensis* and the deer and pigs on which they regularly feed (Auffenberg 1978, 1981). In *V. komodoensis* species ambushes are usually performed in areas of high prey concentrations, even when such concentrations occur only during short parts of the day. On the other hand, there is some evidence that younger Komodo monitors are not as area-oriented as are the adults, and this seems to be the case in *V. bengalensis* as well, though proof is lacking. If true, then it suggests that area-concentration and, particularly, one prey-one place associations take a long time to develop. However, the tendency to return to successful hunting sites is clear, even if the successful encounter was several weeks previous. In the Komodo monitor there is evidence that the location of such successes may be remembered for at least several months. It is even possible that many of the ambush sites visited over several days foraging may represent a series of previously successful prey encounter sites and that the consistency of the foraging foray movements may be based on such earlier successes. This study has shown that in *Varanus bengalensis* about one-third of the time spent in a foraging bout is spent at previous successful food encounter sites.

It has been shown above that the perceptual field of *Varanus bengalensis* is greatly widened by the rhythmic lateral bending of the head and body. But the actual field recognized is probably similar to that demonstrated for herring larvae (Rosenthal and Hempel 1970), being in the form of an undulating tube (Fig. 7). Curio (1976) has suggested that similar lateral movements in fishes tend to increase the mean diameter of the predator, thus increasing

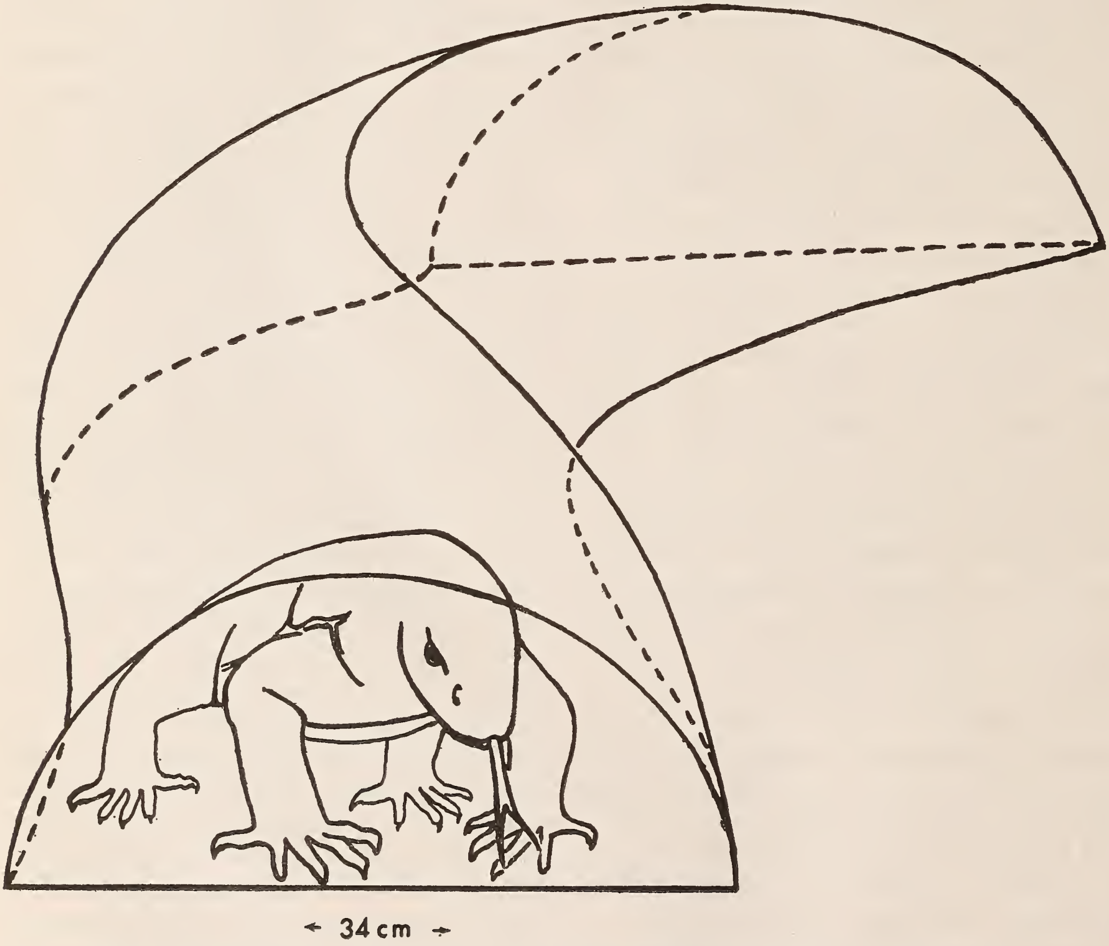

Fig. 7. Diagrammatic representation of presumed undulating perceptual tunnel about 34 cm wide in adult *Varanus bengalensis* (adapted from illustrative concept of Rosenthal and Dawkins, 1970).

their discrimination efficiency. This is clearly the case in *Varanus bengalensis.*

While the present study has helped elucidate certain factors regarding the behaviour of foraging monitors in the field, many important questions remain. Most of these can be answered only after more thorough study in both the field and laboratory. To date most studies of the ethology of predation have used insects, birds, fishes, and mammals as subject groups. Little work has been done in this field with reptiles. Yet, there is much about reptile behaviour suggesting that the patterns in this group are not the same as have been demonstrated previously (*see* Curio 1976). Hopefully this report will stimulate others to further investigate the feeding strategies of particularly the snakes, in which notoriously little has been reported, but for which much good work could easily be done in the laboratory in view of their general adaptability to captive situations.

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BREEDING HABITS AND ASSOCIATED PHENOMENON IN SOME INDIAN BATS[1]

Part VIII — *Taphozous melanopogon* (Temminck) — Emballonuridae

V. M. Sapkal and K. G. Khamre[2]

Specimens of *Taphozous melanopogon* (Temminck) were collected from dungeons and passages of old discarded forts at Narnala, Chikaldhara, Mandu and Raysen. The population varies at the colony during different seasons. It has a sharply defined annual breeding cycle. Young are delivered between the last week of May and first week of June. The gestation period is about 120 to 125 days. The newly born young are 7 to 8 g in weight and are weaned when they attain a body weight of 20 g. There is a complete dominance of the right side of the female genitalia over the left, and, as a rule, ovulation occurs from the right ovary and conceptions in the right cornu. The left side of the genitalia is functional in very exceptional cases. The young do not attain sexual maturity within the first year of birth. The colony shows an even sex-ratio only during the season of copulation, whereas the males are more numerous in the colonies examined during the rest of the year. Evidently, the females migrate from these colonies during the sexually quiescent period.

INTRODUCTION

Information concerning the details of breeding habits and sex-cycle on Indian emballonurid bats is confined to a brief description of the breeding habits and ovarian cycle in *Taphozous longimanus* (Gopalakrishna 1954, 1955) and to a preliminary account of the breeding behaviour of *Taphozous melanopogon* (Khaparde 1976) inhabiting temples of Bhuvaneshwar, Orissa. Even these short accounts have revealed that there are basic differences in the breeding sexual activity of the two species which are so closely related taxonomically. Whereas, *Taphozous longimanus* (Gopalakrishna 1954, 1955) is a continuous breeder with a quick succession of pregnancies with the two horns of the female genitalia functioning alternately, *Taphozous melanopogon* (Khaparde 1976) is a restricted breeder with the right side of the genitalia being functional. Further, there appears to be differences in the breeding pattern of *Taphozous melanopogon* in different climatic and ecological situations. Hence, a detailed study has been undertaken to study the breeding habits and sexual cycle of *Taphozous melanopogon* collected from three different localities in Central India, but having nearly the same ecological conditions.

MATERIAL AND METHODS

The specimens of *Taphozous melanopogon* (Temminck) were collected from dungeons and passages of old forts at Narnala, Chikhaldara, Mandu and Raysen. All these localities are situated in the midst of dense jungle. Collection from Narnala were made so as to have one

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TABLE I

SUMMARY OF THE COLLECTION DIARY

Date of Collection	Place of Collection	Males				Females							Total
		Immature		Mature	Total no. of Males	Immature		Mature				Total Number of Females	Number of Specimen
		Suckling	Free			Suckling	Free	Non-Pregnant	Pregnant		Lactating		
									Rt. horn	Lt. horn			
1	2	3	4	5	6	7	8	9	10	11	12	13	14
6.1.78	Chikhaldara	—	—	3	3	—	1	—	—	—	—	1	4
11.1.78	,,	—	—	2	2	—	1	1	—	—	—	2	4
14.1.78	Narnala	—	8	13	21	—	6	4	—	—	—	10	31
22.1.78	,,	—	2	9	11	—	1	2	—	—	—	3	14
23.1.78	Chikhaldara	—	1	3	4	—	—	—	—	—	—	—	4
27.1.77	,,	—	—	3	3	—	—	3	2	—	—	5	8
27.1.80	Narnala	—	11	14	25	—	—	2	15	—	—	17	42
30.1.77	,,	—	—	7	7	—	—	—	11	—	—	11	18
30.1.78	Chikhaldara	—	—	2	2	—	—	—	3	—	—	3	5
5.2.78	Narnala	—	1	8	9	—	—	—	1	—	—	1	10
9.2.79	,,	—	—	4	4	—	—	3	4	—	—	7	11
10.2.79	,,	—	2	4	6	—	—	3	—	—	—	3	9
11.2.78	Chikhaldara	—	—	1	1	—	—	—	7	—	—	7	8
23.2.77	Narnala	—	1	2	3	—	—	—	3	—	—	3	6
3.3.77	Narnala	—	—	3	3	—	—	—	—	—	—	—	3
21.3.78	Chikhaldara	—	5	20	25	—	—	—	2	—	—	2	27
30.3.80	Mandu	—	2	9	11	—	—	—	13	1	—	14	25
15.4.77	,,	—	1	3	4	—	—	2	6	—	—	8	12
29.4.78	Raysen	—	3	9	12	—	—	—	18	—	—	18	30
2.5.78	Mandu	—	2	12	14	—	1	—	9	—	—	10	24
18.5.77	Narnala	—	—	8	8	—	—	—	—	—	—	3	11
29.5.77	Mandu	2	—	—	2	—	—	—	—	—	2	2	4
30.5.77	,,	—	1	7	8	—	—	—	9	—	—	9	17
15.6.78	,,	9	3	10	22	5	1	4	—	1	17	28	50

TABLE I (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14
19.6.77	Narnala	—	—	11	11	—	—	—	—	—	—	—	11
1.7.77	Mandu	1	1	3	5	2	—	3	—	—	—	5	10
9.8.76	Chikhaldara	—	—	14	14	—	—	—	—	—	—	—	14
27.8.77	,,	—	—	8	8	—	—	—	—	—	—	—	8
20.9.76	,,	—	—	6	6	—	—	—	—	—	—	—	6
30.9.76	Mandu	—	—	5	5	—	2	2	—	—	—	4	9
1.10.77	,,	—	2	10	12	—	6	5	—	—	—	11	23
4.11.76	Narnala	—	—	—	—	—	—	2	—	—	—	2	2
5.11.76	,,	—	—	1	1	—	3	1	—	—	—	4	5
7.11.76	Chikhaldara	—	—	3	3	—	—	—	—	—	—	—	3
16.11.78	Narnala	—	1	16	17	—	4	5	—	—	—	9	26
17.11.76	,,	—	2	5	7	—	2	3	—	—	—	5	12
14.12.76	Chikhaldara	—	—	6	6	—	3	—	—	—	—	3	9
17.12.76	Narnala	—	4	7	11	—	5	4	—	—	—	9	20
20.12.77	Chikhaldara	—	4	3	7	—	2	2	—	—	—	4	11

TABLE II

MONTH-WISE COLLECTION OF SPECIMENS

Month	Males	Females	Total
January	78	52	130
February	23	21	44
March	39	19	58
April	16	26	42
May	32	24	56
June	33	28	61
July	5	5	10
August	22	0	22
September	11	4	15
October	12	11	23
November	28	20	48
December	24	16	40
	323	226	549

collection or more representing each month. The specimens were collected only a few times from the other two localities. Since there is no difference in the breeding behaviour of the specimens in the different localities, the descriptions are common except where a special mention is made regarding specimens from a special locality.

The specimens were caught at random during the daytime with a butterfly net and brought to the laboratory alive. After noting down the significant characters of the external genitalia in the male and mammary glands in the female, the specimens were killed by chloroform and their body weights recorded by a sensitive spring balance. After fixation of the dissected genital tracts in suitable fixatives they were preserved in 70% alcohol. In the case of males, the right testis of each specimen was taken out of the preservative 70% alcohol, rolled on filter paper and quickly weighed in a Mettler balance. Although this does not give the actual weight of the testis, this gives a correct picture of the relative weights of the testes of the different specimens, since the testes of all the specimens were subjected to the same procedure.

Table I is a summary of the collection diary, and Table II gives the monthwise collection of specimens.

OBSERVATIONS

Taphozous melanopogon is a medium sized bat which lives in colonies in which the population varies during the different seasons of the year. The largest colony studied for the present report was found at the main fort of Mandu, having a population of 12,000 to 15,000 specimens. The specimens clung to the rough surfaces of the wall or were inside cracks in the walls. At Narnala also a colony of *Taphozous melanopogon* was located in an old fort, and the specimens were found in narrow dark tunnels within the walls of the fort. The colony contained about 2000 to 3000 specimens. At Chikhaldara there was a colony of 400 to 500 specimens in narrow passages of an old fort. The roost was almost empty at Narnala and Chikhaldara during April. During March and August the roost at Chikhaldara has mostly males with a very small number of females. Evidently, the specimens migrate to some other place during these months, and it appears as if the females leave the colony during certain months of the year and roost elsewhere.

Taphozous melanopogon is a medium sized bat with an adult body weight ranging from 25 to 35 g. The males have a dark brown fur on the body and are easily recognisable by their having a black beard. The gular pouch, which is so characteristic of other species of *Taphozous* is not present in *Taphozous melanopogon*.

Female genitalia:

The ovary is ellipsoidal in shape measuring 1.00 mm in length, 0.7 mm in breadth and 0.8 mm in the middle. It is attached to the mesovarium by a broad hilus and is enclosed in a complete ovarian bursa. The Fallopian tube arises from the postero-mesial aspect of the bursa, traverses along the anterior margin of the bursa curves caudally passing on the lateral side of the bursa and opens into the cranial end of the respective uterine cornu. In the nonparous females the two uterine cornua are nearly equal in length (8.0 mm) and meet caudally to form a 'V'-shaped structure. In the parous females the right uterine cornu is distinctly thicker than the left. The vagina is 14 mm long has a transverse slit-like opening.

Examination of serial sections reveal that the lumen of the uterine cornu do not become widely confluent to form an uterine body, but the lumen of each cornu continues independently as a distinct canal without the typical uterine glands, and joins its counterpart of the contralateral side only near its distal end to open by a common opening at the tip of the cervix.

Breeding Habits:

The breeding behaviour of *Taphozous melanopogon* is same in all the three localities from which the specimens were collected for the present study. Hence, the present observation are common to specimens of all three localities. Special mention of any specific locality is mentioned only where pertinent.

An examination of the collection diary and Table I reveals several interesting feature. Pregnancy, as evidenced by the presence of bulbous uterine cornu, was noticed during the period between 5th February and 30th May. With the exception of two atypical specimens, all adult females collected on 15th June had delivered their young and the uterine cornu, which bore the conceptus, had become completely involuted and had reached the normal condition. Many of the specimens were carrying well grown young at their breasts. These facts indicate that these females had delivered their young atleast 10 to 15 days before. This is further substantiated by the fact that two females collected on 29th May had delivered and were in full lactation. They carried a newly born young each at the breast. Both the young were nearly naked, had adherent eyelids and had a stump of an umbilical cord, one young weighed 7 g and the other 8 g. The average weight of a full term foetus ranged between 7 to 8 g. Evidently, they had been delivered just a few hours earlier — about 8 to 10 hours before. The rest of the specimens collected on 29th and 30th May were heavily pregnant and carried full term conceptuses which would have been delivered in a day or two. It appears that all the females in the colony, barring the two exceptional specimens collected on 15th June, delivered their young during the two weeks — the last week of May and first week of June.

Microscopic examination of the female genitalia of specimens collected during January revealed that copulation had not occurred in any female collected upto 23rd January. Two females collected on 27th January had sperms in the uterus, an early corpus luteum in the ovary and an egg in early cleavage in the ovarian part of the Fallopian tube. Most of the adult specimens collected on 30th January had either late morulae or early blastocysts. The specimens collected on 5th February had late implanted blastocysts. From this date onwards the females carried progressively advanced conceptuses until delivery during the last week of May or first week of June.

The facts indicate that *Taphozous melanopogon* has a sharply defined annual breeding cycle. Secondly, copulation is immediately followed by pregnancy, which advances progressively during the following weeks. Pregnancy was not noticed at any other period of the year.

The first batch of newly delivered young were obtained on 29th May and these, as has already been shown, might have been delivered a few hours before. The young ones collected on 1st July weighed 15 to 17 g and were free. The adult females, however, were still in lactation, and milk oozed out of the nipples when the mammary glands were pressed. No specimen in lactation was collected after this date.

From the above description of the breeding habits of *Taphozous melanopogon,* the annual life of the adult female of this species can be recognised into the following periods:

1) Period of sexual quiescence — from the middle of July to the third week of January.
2) Oestrus — copulation and fertilization during the last week of January.
3) Pregnancy — from the last week of January to first week of June.

This has been arrived at by taking into consideration that the sucklings obtained on 1st June were reasonably well grown, but not grown enough to become completely independent. The maximum weight of the young collected on that date was 17 g. On 9th August when the next collection was made, the young were free and independent, and the lowest body weight was 24 g. Looking at the rate of growth of the young it is reasonable to assume that the sucklings obtained on 1st July would be weaned by about 10th to 15th of July when they attain a body weight of about 20 g.

While the above pattern of sexual life of the female is the normal situation, there were noticed two unusual and exceptional specimens, one on 29th April and the other on 15th June. While all other pregnant specimens collected on 29th April were nearly of one stage of pregnancy, the exceptional specimen carried a conceptus which was distinctly smaller than the others. Likewise on 15th July while all other specimens had delivered their young and the uterus in these had undergone complete involution, there was one specimen which carried a full term foetus, which, judging by its size, would have delivered in a day or two. Strangely, while in all other cases the pregnancy was distinctly carried in the right uterine cornu, these two exceptional specimens carried the conceptus in the left cornu. Evidently, there is a very small number of females in the colony which conceive later than all others, and while the number of specimens exhibiting such unusual behaviour is too small to warrant any generalization, it is strikingly extraordinary that only these should be carrying the pregnancy in the left cornu. Perhaps they missed or underwent unfruitful copulation or there was an early degeneration of the ovum released from the right side, and may have induced the left ovary to release an ovum from the left ovary at a later date within the breeding season.

It is interesting to note that amongst the emballonurid bats, while *Taphozous longimanus* (Gopalakrishna 1954, 1955), *Rhychonyteris naso* (Burt and Stirtos 1961) breed throughout the year, *Taphozous georgianus* (Kitchner 1973) and *Taphozous magnis* (Al Rabaake 1968) breed once a year in a sharply defined season. *Taphozous melanopogon* resembles the latter two species in this respect. It is interesting that two closely allied species such as *Taphozous longimanus* (Gopalakrishna 1954, 1955) and *Taphozous melanopogon* living under the same climatic conditions possesses divergent breeding habits.

Number of young and symmetry of female genitalia

Among the 89 pregnant females which exhibited unquestionable pregnancy, 87 carried the conceptus in the right cornu and two in the left. The examination of the ovaries of 46 specimens carrying the conceptus in the right cornu revealed that the corpus luteum was invariably present in the ipsilateral ovary. The examination of the ovaries of the two exceptional specimens carrying pregnancy in the left cornu showed that in both these cases the ovary of the left side had released the ovum as revealed by the presence of a corpus luteum. The ovary of the nonfunctional side showed a typical anoestrus condition in all the species.

The genitalia of all the females collected on 27th and 30th January were examined histologically since copulation took place during this period. Out of 36 such females 31 had released the ovum from the right ovary, 3 had a preovulatory follicle each in the right ovary and the other two were immature females. These facts show that the right ovary is the normal functional ovary in this species and the embryo implants in the ipsilateral cornu. It is in very exceptional cases that the left ovary releases the ovum and the embryo implants in the left cornu. The exceptional situations occur only in the very few specimens in which there is delayed copulation and ovulation. Hence, these specimens conceive at least 2 to 3 weeks later than the other specimens. Evidently, the right side of the female genitalia is nearly completely physiologically dominant in this species. The left side becomes functional only under very exceptional conditions.

Duration of pregnancy:

The collection diary and Table I indicates that pregnancy in progressively advanced stages occur between 5th February and 30th May. Two specimens each carrying a young weighing 7 g were obtained on 29th May 1977. Both were nearly naked on the belly, reddish in colour and had still a small umbilical stump which had not withered. Their eyelids had not yet opened. This, taken along with the fact that the weight of the full term foetus (average of 7 foetuses obtained from specimens collected on 30th May 1977), indicates that the two sucking young ones collected on May 1977 must have been delivered a few hours before.

Histological examination of the specimens collected in January showed that the earliest date when a fertilised egg was noticed was 27th January, and during the following days the specimens contained progressively advanced embryos either in the Fallopian tube or in the uterus. Implanted blastocysts were present in specimens collected on 5th and 9th February.

From the above data it is evident that the duration of pregnancy in *Taphozous melanopogon* is 120 to 125 days allowing a couple of days on either side — the date when fertilisation was observed (27th January) and the date when the first batch of young ones were collected (May, 29).

Growth and maturity:

The collection diary and Table I reveals some interesting data on the growth and age of maturity in *Taphozous melanopogon.* Except the specimens, which are attached to the breast of the mother during the suckling period, it is not possible to determine the maturity or otherwise in this species in the free specimens on the basis of the size and body weight. By the time the young ones leaves the mother, it is nearly of the same size as the mother and very soon attains adult body weight. Thus, after about three months after birth the immature animals cannot be distinguished from the adults on the basis of the size of the body. However, the size of the testis in male and the size and nature of the mammary nipples and the fact whether the uterus contains an embryo or not in the female are valid criteria to determine sexual maturity or otherwise. On the basis of these criteria it is evident that during the sexual season there are many immature males in the colony. Likewise there are many nonpregnant females in the colony during the season of pregnancy. Since this species breeds only once a year in a sharply defined period, since there are immature specimens in the colony during the breeding period, it is evident that the animals of this species do not attain sexual maturity within the year of their birth. Since, the young ones are delivered late in May or early in June, since the reproductive season commences in the last week of January and since the animals do not attain sexual maturity within the year of their birth, the animals are atleast 21 months of age (from the end of May to the end of January of the year after the year of birth) when they come to sexual activity, and the female is atleast 24 months before she delivers her first young.

Consequently, during the beginning of the breeding season the colony has atleast three kinds of individuals: (i) the immature ones, (ii) those which would be experiencing their first sexual season and (iii) those which had experienced sexual activity atleast once before. The data at present do not warrant a definite conclusion regarding the possible longevity of the species. The animal has to produce atleast 3 young ones for the preservation of the species allowing for possible early mortality. This would mean that this specimen should live atleast for 50 months to produce 3 young and wean the last one. Brosset (1962 a), who made observations on this species, noticed the dead bodies of many young ones during suckling periods. He reported that atleast 30 per cent of the young ones born in the colony each year are thus lost before they are weaned. If this factor is added to the normal expected minimum maturity, then each female may lose

1/3rd the number she delivers. Hence, she should produce atleast four young in her life time to perpetuate the species. Brosset's (1962a), and the present observations indicate that the colony actually increases in size and after reaching a certain maximum, the spillover of the population migrate to form another colony. This demands that atleast five young should be produced by the female in her life time. Hence, the female should have a minimum longevity of atleast 74 months allowing for the weaning of the 5th young born to the female.

Sex-ratio:

The collection record and Table II indicates that out of the total 549 specimens collected of all ages there were 323 males and 226 females. This gives a male dominant uneven sex-ratio of 5 to 3% males in the population. Earlier observations of Abdulali (1949) also revealed an uneven male dominant sex-ratio for this species and also for *Hipposideros lankadiva.* In all other bats, in which the sex-ratio has been studied so far, there is a preponderance of the female (Gopalakrishna 1974). The present study on *Taphozous melanopogon* has revealed some extremely interesting data. Although specimens have been collected throughout the year and from different (three) localities and although in all the localities the total number of males collected was more than the females, it appears it would be fallacious to draw conclusion on the data thus obtained in the case of *Taphozous melanopogon.* This caution is indicated by the following facts. The number of sucklings obtained is too small to be of any statistical significance. The collection record during the season of copulation (between January 16 and January 30) shows that among the mature animals there were 26 males against 31 females giving nearly even sex-ratio with the females being slightly more than the males. During the entire period of sexual activity from copulation to delivery, there were 111 males and 111 females. Evidently, the imbalanced sex-ratio as revealed by the total collection is due to the difference in number of the adult males to adult females during the nonsexual season (from June to the last week of the following January) when collection contained 149 mature males and only 13 mature females. This shows that except during the sexual season the males and females live segregated. It is also interesting to note that, while the males remain in the original colony, the majority of females migrate to some other place.

It is difficult to determine the accurate sex-ratio of colonial bats, which tend to live in sexually segregated colonies during different seasons of the year, unless it is possible to establish their migratory routes and the place where the emigrant bats roost. Hence, the sex-ratio of this species as revealed by the collection record is not valid. Perhaps Abdulali (1949) also drew conclusion on the sex-ratio of this species on the basis of only a few collections and from one or two male dominant colonies. A survey of many colonies of this species within its migratory distance is necessary for understanding the exact sex-ratio in this species.

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POTAMOGETON IN NORTH WESTERN HIMALAYAS[1]

A. Majeed Kak[2]

(*With twelve text-figures*)

Potamogeton L. (Potamogetonaceae) constitutes' a natural genus with about 100 species (Airy Shaw 1966), wide spread throughout the world, except in the polar regions. The species commonly known as "Pond Weeds", are one of the most important food resources of waterfowls — which include migrant marsh birds and shore birds. Most of the species provide food, shelter and shade for fish and minute animal life. The most important species used as manure in floating islands of Kashmir lakes is curled pond weed (*P. crispus* L.).

Hook. f. (1893) reported 9 species from the Indian subcontinent, which was reduced to 4 by Subramanyam (1962). Stewart (1972) from his personal and early collections reported 11 species from the Himalayas. I accept 14 species of *Potamogeton* L. as occurring in the north western Himalayas. Two species are reported for the first time from the Indian subcontinent. Brief descriptions of all the species are given. Voucher specimens are deposited in the Herbaria, the University of Kashmir, University of Alabama (U.N.A.) and National Botanic Gardens (BSI) Calcutta.

Potamogeton L. Sp. Pl. 126 (1753).

Hydrogeton Lour. Fl. Cochinchinensis 244 (1790).

Patamogeton Honckeny. Syn. Plan. Germ. 2. 110 (1793).

Potamogiton Raf. Med. Respos. 5: 354 (1808).

Potamogetum Clairville. Man. Herb. Suisse & Valais 34 (1811).

Peltopsis Raf. Jour. Phys. Chim. Hist. Nat. Arts. 89. 102 (1819).

Spirillus J. Gay. Compt. Rend. Hebd. Seances. Acad. Sci. 38. 703 (1854).

Potamogeton : Rootstocks creeping. Stems usually branched. Leaves stipulate, stalked or sessile, entire or finely toothed. Flowers small, perfect; perianth segments 4, green; anthers 4; ovary of 4 distinct, sessile 1 celled, 1 ovuled carpels. Druplets or nutlets small, more or less beaked.

Artificial key to the species

1. Leaves linear lanceolate, ovate or suborbicular; stipules not adnate to the leaf base; spikes stiff and compact
    2. Upper leaves mostly floating, ovate-suborbicular
        3. Floating leaves oblong lanceolate or elliptic lanceolate; petiole shorter than lamina
            4. Beak of the nutlets very short, hooked .... *P. octandrus*
            4. Beak of the nutlets short and stout
                5. Rootstocks persistent; prostrate, internodes somewhat thickened .... *P. fluitans*
                5. Rootstocks annual, springing form a resting bud, which is deciduous or attached to a short persistent stolen; internodes not thickened .... *P. alpinus*

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3. Floating leaves oval or ovate, as long as broad or longer than broad; petioles equal or much longer than lamina

6. Submerged leaves reduced to phyllodes; peduncles thick at the base of the spike .... *P. natans*

6. Submerged leaves linear to linear obovate; peduncle not thickened at the base of spike

7. Stipules subpersistent, 2-4 cm long, obtuse; upper leaves recurved not keeled .... *P. polygonifolius*

7. Stipules decaying early, linear, acute or obtuse 3-9 cm long; upper leaves more or less 2 keeled

8. Nutlets obovoid, 2.5-3.5 mm long, acutely keeled; beak short but stout .... *P. nodosus*

8. Nutlets obovoid, 3.0-4.9 mm, scarcely keeled beak long slightly curved .... *P. tepperi*

2. Upper leaves submerged or partly floating, linear lanceolate

9. Leaves sessile

10. Leaves linear usually crisped or serrulate, 3 ribbed..... *P. crispus*

10. Leaves ovate or cordate, never crisped or serrulate, 5-9 ribbed .... *P. perfoliatus*

9. Leaves petiolate

11. Upper leaves submerged; peduncles mostly solitary .... *P. lucens*

11. Upper leaves slightly emergent or floating peduncles usually in clusters .... *P. zizi*

1. Leaves setaceous or linear, filiform; stipules wholly or partly adnate to the leaf base; spikes loose or monoliform

12. Plants dwarf; stems compressed branched throughout .... *P. pusillus*

12. Plants tall or medium sized; stems terete, simple or branched apically

13. Copiously branched apically forming mats, less branched at the base; leaves 1 nerved; stigma not discoid; beak facial usually recurved ...*P. pectinatus*

13. Slightly branched apically, unbranched near the base; leaves 3 nerved; stigma disc shaped; beak short almost subcentral with truncate apex........ .... *P. filiformis*

Potamogeton tepperi A. Benn. in Jour. of Bot. xxv. 178 (1887); Ascherson & Graebner. Potamogetonaceae 31. 62 (1907).

P. odontocarpus Gandog. Bull. Soc. Bot. France 3 ser VI. 393 (1899).

This broad leaved pondweed is often confused with *P. natans*. In the field it can be distinguished by the following characters: phyllodes absent; upper leaves floating, ovate-lanceolate, base cordate light pink beneath with 20-30 prominent nerves.

Anchar lake; AMK 3144, Dal lake; AMK 3193, Nagin lake; 3812, Leper Hospital AMK 3879.

Clarke's (1895) plate 29142 based on collections from this area preserved in the Kew Herbarium was studied by Ascherson and Graebner (1907) who pointed out its presence here. Since then the plant has been overlooked by collectors.

Potamogeton polygonifolius Pourret. Act. Toulouse, 3: 325 (1734): Fryer *et al. Potamogetons* of Brit. Is. 18 (1913).

The species is very close to *P. natans* and *P. nodosus* from which it can be differentiated on the basis of characters given in the key. (Fig. 1).

Hokhar sar; AMK 3645, Hazrat bal; AMK 2025, Nagin lake; AMK 3367, Verinag; AMK 3139.

A highly plastic species, *P. polygonifolius* is susceptible to the influence of altitudinal and other conditions, e.g. depth of water. Sometimes it grows on wet banks and then is stunted and without reproductive organs.

Potamogeton natans L. Sp. Pl. 126 (1753); Hook. f. Fl. Brit. Ind. 6: 565 (1893); Collett, Fl. Siml. 547 (1902); Yuzepehuk in Kom., Fl. URSS 1: 200 (1934); Fryer l.c. 4; Clapham, *et al.* Fl. Brit. Is. 946 (1962); Fassett, Man. Aq. Pl. 55 (1972); Dandy in Rech. f. Fl. Iran. 83: 3 (1971); Stewart Ann. Cat. Vas. Pl. W. Pak. and Kash. 29 (1972).

Leaves heterophyllous, all stalked; lower ones reduced to phyllodes; upper floating, ovate lanceolate to elliptical. Nutlets compressed, obovate usually reduced on the back, rarely with an acute keel, dorsal margins reduced; beak short.

Dal lake, AMK 3875; Anchar lake, AMK 3354.

Potamogeton nodosus Poiret in Lam. Encycl. Meth. Bot. Supp. 4; 535 (1816); Yuzepchuk l.c. 199; Fernald, Gray. Man. Bot. 8: 76 (1950); Clapham, et al l.c. 947; Dandy in Rech. f. l.c. 3; Stewart, l.c. 29; Khatija et al. l.c. 4.

P. indicus auct. non Roth. Fl. Ind. 1: 471 (1820); Hook. f. Fl. Brit. Ind. 5: 565 (1893); *P. oblongus* auct. non. Viv. Aitch, in J. Linn. Soc. Bot. 18: 99 (1830); *P. natans* auct. non. L. Rech. f. Fl. Lowland Iraq 27 (1964).

Common plant of this area. Often confused with *P. natans* and *P. polygonifolius,* but can be separated by the characters given in the key. (Fig. 2).

Highgam Rakh, AMK 3190; Nagin lake, AMK 1811; Dal lake, AMK 3874.

Potamogeton octandrus Poir. in Lam. Encycl. Meth. Bot. Suppl. 4: 534; Stewart, l.c. 29; Khatija, *et al.* l.c. 7.

P. juvanicus Hussk. in Act. Soc. Sci. Ind. Neerl. 1.8: 26 (1856); Hook. f. l.c. 566; Collett, l.c. 547; Yuzepchuk in Kom. l.c. 195. Bennett. Fl. Trop. Afr. 8: 220 (1901).

Grows in quiet or slow flowing waters, also in irrigation channels. The species superficially resembles *P. nodosus* but can be distinguished from it by the petioles being longer than the blades and the spikes usually shorter than in *P. nodosus*; Nutlets with hooked beak; ribs often toothed in *P. octandrus.* (Fig. 3).

Dal lake, AMK 3283; Shalimar, AMK 3067; Malgam, AMK 3879, 3810.

Potamogeton lucens L. Sp. Pl. 126 (1753); Boiss, Fl. Or. 5: 567 (1882); Hook f. l.c. 567; Collett, l.c. 448; Yuzepeckuk in Kom. l.c. 202; Clapham, l.c. 948; Dandy, in Roch. f. l.c. 4; Stewart. l.c. 29; Khadija *et al.* l.c. 5.

Grows abundantly in our lakes; highly plastic; leaves elliptic lanceolate or oblong ovate, sessile or subsessile acute or acuminate. Nutlets faintly keeled, obtuse on the back, lateral ribs obscure, beak short, subcentral. (Fig. 4).

Economically less useful; used as manure along with other aquatic weeds.

Dal. lake, AMK 3407; Highgam Rakh, AMK 3689; Bemma, AMK 461.

Potamogeton lucens var. **acuminatus** (Schumach) Fries. Novit. Fl. Suec. ed. 1, 46 (1816); Ascher & Graeb. Potamogetonaceae 31; 76 (1959). *P. acuminatum* Schumach, Enum. Pl. Saell. 1; 49 (1801); A. Bennett. J. of Bot. XIX, 151 (1891).

The species is restricted to Dal, Manasbal and Nilnag lakes. It can be distinguished from *P. lucens* by the sessile or subsessile lanceolate leaves with 3-5 nerves; apex acuminate much drawn out; spikes mostly curved.

Charchinari, AMK 3635; Ruph lank (Dal lake), AMK 3229.

Potamogeton zizi Mert. et. Koch. Deutschl Fl. 1. 845 (1823); Cham et Schlechtd. in Linnaea II. 202 (1827); Ascher et Graeb. l.c. 81; Fryer, *et al.* 72; Stewart. l.c. 29.

P. lucens subsp. *zizi* Roth. Hook. stued. Fl.

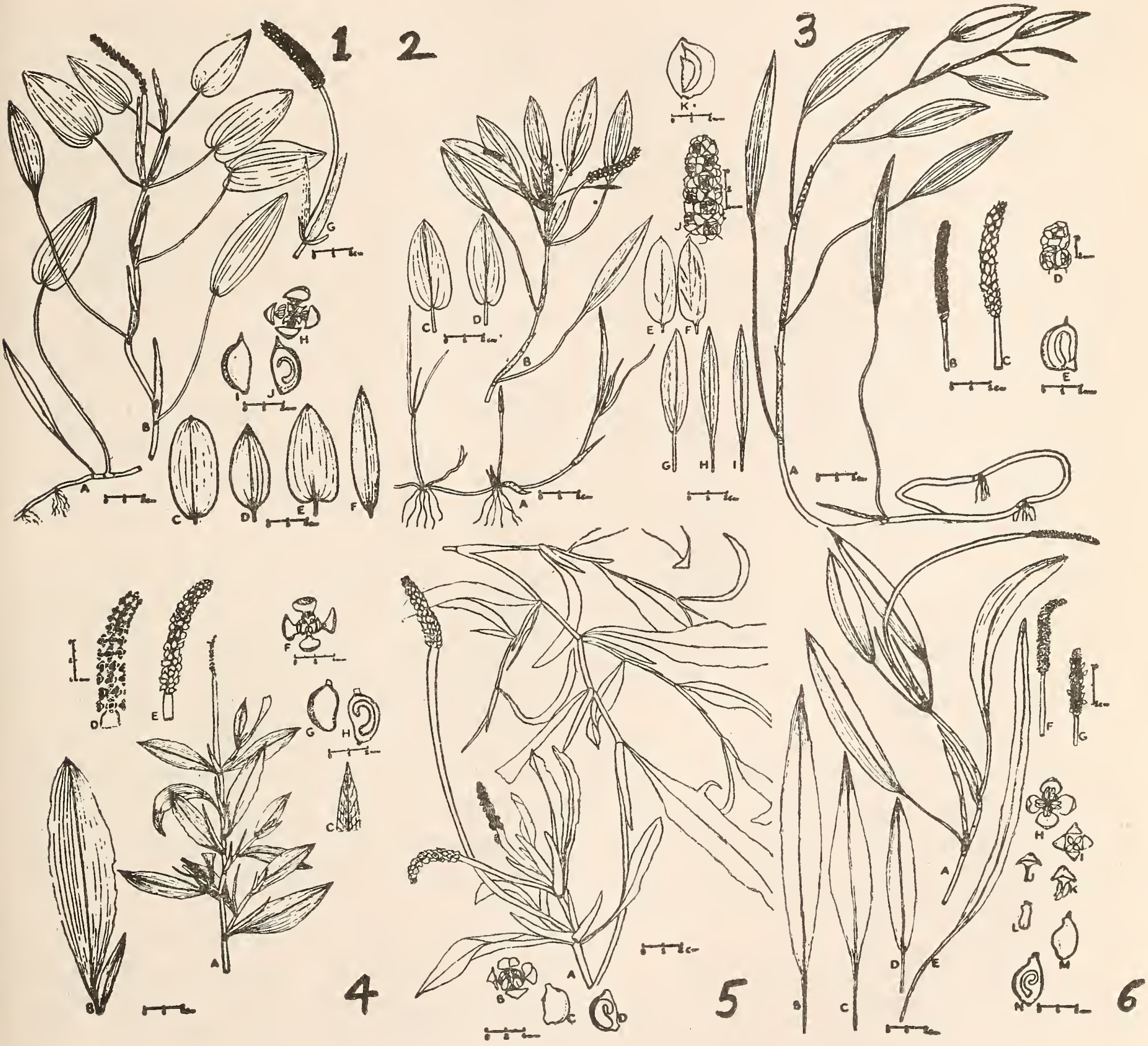

Fig. 1. *Potamogeton polygonifolius* Pourret; Fig. 2. *P. nodosus* Poiret; Fig. 3. *P. octandrus* Poir.; Fig. 4. *P. lecens* L.; Fig. 5. *P. zizi* Mert. et Koch.; Fig. 6. *P. fluitans* Roth.

ed. 3; 433 (1884); *P. lucens* var. *heterophyllus* Fries. Novit. Fl. Suec. ed. 2; 34 (1828).

Superficially similar to *P. lucens* also grows in association with it and *P. fluitans.* It can be distinguished from both by the subsessile leaves and spikes arising in clusters. (Fig. 5).

Manasbal, AMK 3404; Charchenari (Dal lake), AMK 3606; Nagin lake, AMK 3303.

Potamogeton fluitans Roth, Tent. Fl. Germ. 1. 72 (1788); Bennett in J. of Bot. XXIII 375 (1885); Ascherson and Graeb. l.c. 58; Fryer & Benn. l.c. 11. *P. oblongus* var. *fluitans* G. F. May. Chloris, bannov 519 (1836); *P. natans* var. *explanatus* Mert. U. Koch. Deutschl. Fl. I. 837 (1828).

Occurs in fast flowing streams and in irrigation channels, can be distinguished in the field by the long petioled, thin leaves. Stigma exerted; spikes mostly barren. Nutlets 3 keeled, central one acute (Fig. 6).

Nagin lake, AMK 751; Chasma shahi, AMK 3876; Anchar lake, AMK 3193.

Potamogeton alpinus Balbis in Mem. Acad. Sc. Turin Ann. 10-11 Sci. Phys. Math. 1; 329 (1804); Aschers. Fl. Brandeub 658 (1864); Fryer, *et al.* l.c. 11 Calpham, *et al.* l.c. 950; Stewart, l.c. 29; Khatija & Jaffri, l.c. 4. *P. rufescens* Schrad in Cham., Adnot 5 (1815); Boiss, l.c. 16. *P. stylis* Hagstr. in Bot. Not. 98 (1908).

This species can be distinguished from other *Potamogetons* of this area by the following characters; Stems being pale or dark olive green tinged with red or purple; Leaves sessile, oblanceolate-elliptic. Nutlets oblique or obovate, lenticular, acutely keeled, beak subcentral, acute. (Fig. 7).

Nilnag, AMK 1149, 2016, 3890, 3946.

Potamogeton perfoliatus L. Sp. Pl. (1753); Hook. f. l.c. 566; Collett, l.c. 547; Fryer, l.c. 38; Yuzepchuk, l.c. 30; Khatija *et al.* l.c. 5.

This species is easy to identify in the field. Leaves all similar, oval to ovate, suborbicular or oblong lanceolate, sessile, amplexicaul. Nutlets obliquely ovate; beak slightly recurved; subcentral, slightly winged towards the margin. (Fig. 8).

Pulwama, AMK 3279; Panikar (Zanskar, Ladakh), AMK 2031; Thungboo (Zanskar), AMK 877.

The species has considerable variation in the vegetative body and attempts have been made to treat them as distinct varieties (Ascherson & Graeb. 1907). But they seem to be merely different states of the same species produced by local and temporary conditions. Plants growing at high altitude as at Panikar and Parkhacheck (Zanskar) and Drass (Ladakh) have small, rotundifolius leaves resembling var. *rotundifolius* Sonder.

In the valley lakes it is present only and rarely in Anchar lake.

Potamogeton crispus L. Sp. Pl. 120 (1753); A. Bennett, l.c. 8; Boiss, l.c. 17; Hook. f. l.c. 566; Collett, l.c. 547; Fryer, l.c. 43; Clapham, l.c. 256; Dandy in Reich. f. l.c. 6; Stewart, l.c. 29; Khatija, *et al.* l.c. 3.

The early spring pond weed of this area, it is easily recognised. The leaves are flat and acutely serrate when young, but strongly undulate when mature. Nutlets 3 keeled with the central keel slightly winged and crested with a long fleshy tooth at the base, sometimes reduced to a tubercle, but always present in the fresh fruit. Lateral ridges obscure. The var. *serrulatus* (Schrad) Reichb reported from this area is merely an immature stage of the plant. (Fig. 9).

Locally known as *Zai Hill,* it is used as manure; and in the preparation of floating islands with other emergent aquatic plants. Fruits eaten by ducks and other water fowl, also fish feed on the young leaves.

Leper Hospital (Nagin lake), AMK 809;

Dal lake, AMK 3803; Shalimar, AMK 3230; Mirgund, AMK 2083; Highgam Rakh, AMK 2028.

Potamogeton filiformis Pers. Syn. Pl. 1 : 152 (1805); Clapham, *et al.* l.c. 957. Dandy in Rech. f. l.c. 7; Stewart, l.c. 29; Khatija & Jaffri, l.c. 10.

P. setaceus auct. non. Linn. Schum. Enum. Pl. Saell. 1:51 (1801).

P. pamiricus Vid, Meddel. Nat. Foren. Kjobenhavn. 182 (1903).

Often overlooked by collectors as it superficially resembles *P. pectinatus.* It can be distinguished in the field by the character that it

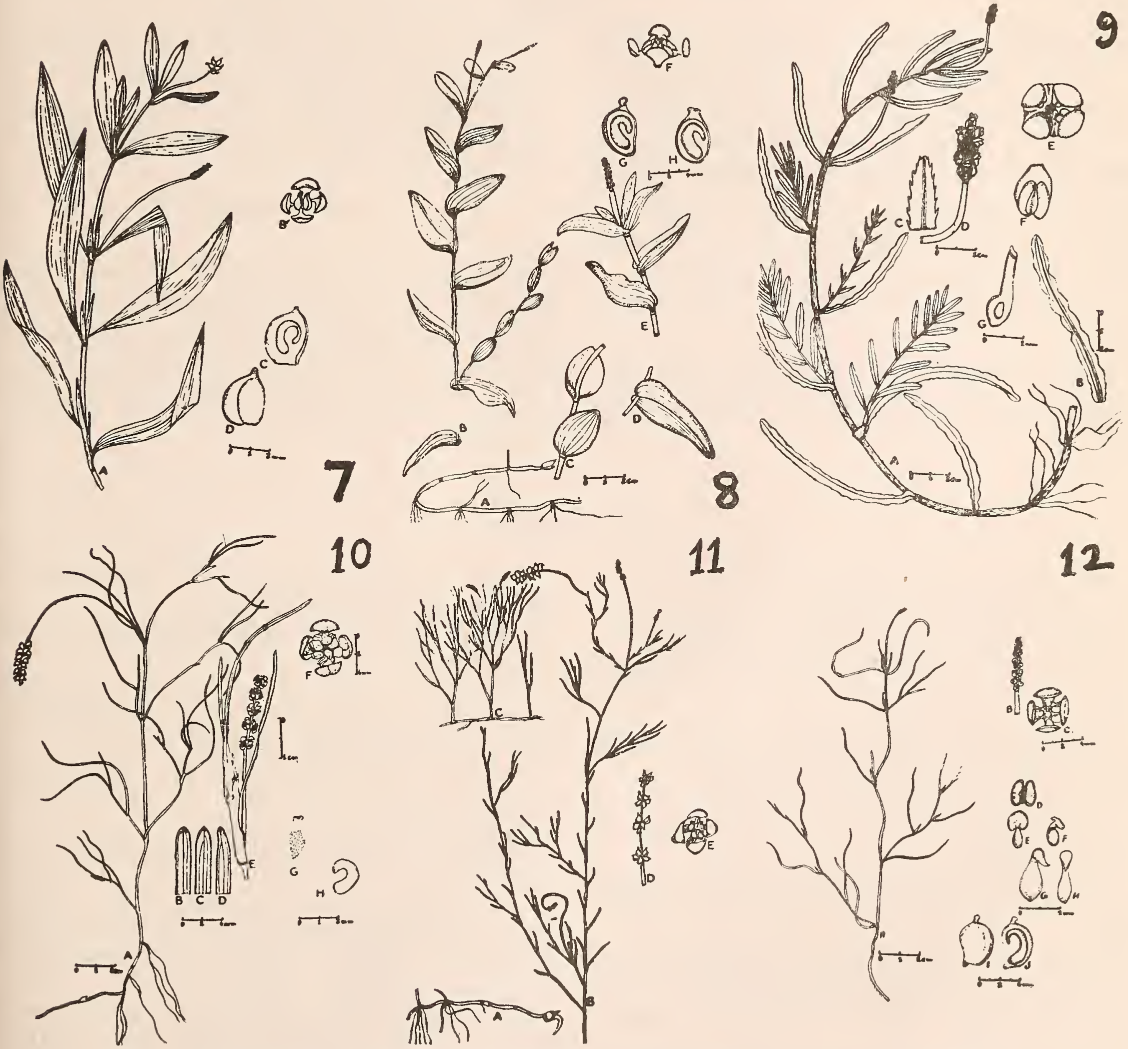

Fig. 7. *Potamogeton alpinus* Balbis; Fig. 8. *P. perfoliatus* L.; Fig. 9. *P. crispus* L.; Fig. 10. *P. filiformis* Pers.; Fig. 11. *P. pectinatus* L.; Fig. 12. *P pusillus* L.

branches uniformly from base to the apex. Leaves submucronate, mostly 3 nerved, stigma disc shaped. Nutlet beak facial, usually recurved. (Fig. 10).

Common in slow or fast moving cold streams.

Drass, AMK 3709; Menamarg, AMK 3686; Tungboo (Zanskar), AMK 936; Panikar, AMK 3874.

Potamogeton pectinatus L. Sp. Pl. 129 (1753); Hook. f. l.c. 567; Boiss, l.c. 18; Fryer *et al.* l.c. 86; Stewart l.c. 29; Khatija & Jaffri, l.c.

Copiously branched near the apex, forming thick mats on or just below the surface. Leaves narrowly ovate, usually 1 nerved, stigma not discoid, stipular sheath open. Leaves narrowly acute, Style short. Nutlets large. (Fig. 11).

Mostly in the lakes, rarely in slow flowing streams.

Mirgund, AMK 929; Nagin lake, AMK 746; Manasbal lake, AMK 730; Dal lake, AMK 1146.

Potamogeton pusillus L. Sp. Pl. 127 (1753): Hook. f. l.c. 567: Khadija Aziz and Jaffri, l.c. 9.

Much branched, submerged herb, often confused with *P. pectinatus* and *P. filiformis.* It can be separated from both as it grows totally submerged, and is a dwarf form. Nutlets obovoid, obliquely elliptic, 3 keeled with a short central beak. (Fig. 12).

Mostly in fresh and brackish waters of ponds, streams, and in irrigation channels.

Saida Kadal, AMK 3024; Leper Hospital, (Nagin), AMK 3274; Dal lake, AMK 3802.

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BOMBAY NATURAL HISTORY SOCIETY

The Builders and the Guardians

Part 4

SALIM ALI

(*With four plates*)

[*Continued from Vol.* 79(1): 46]

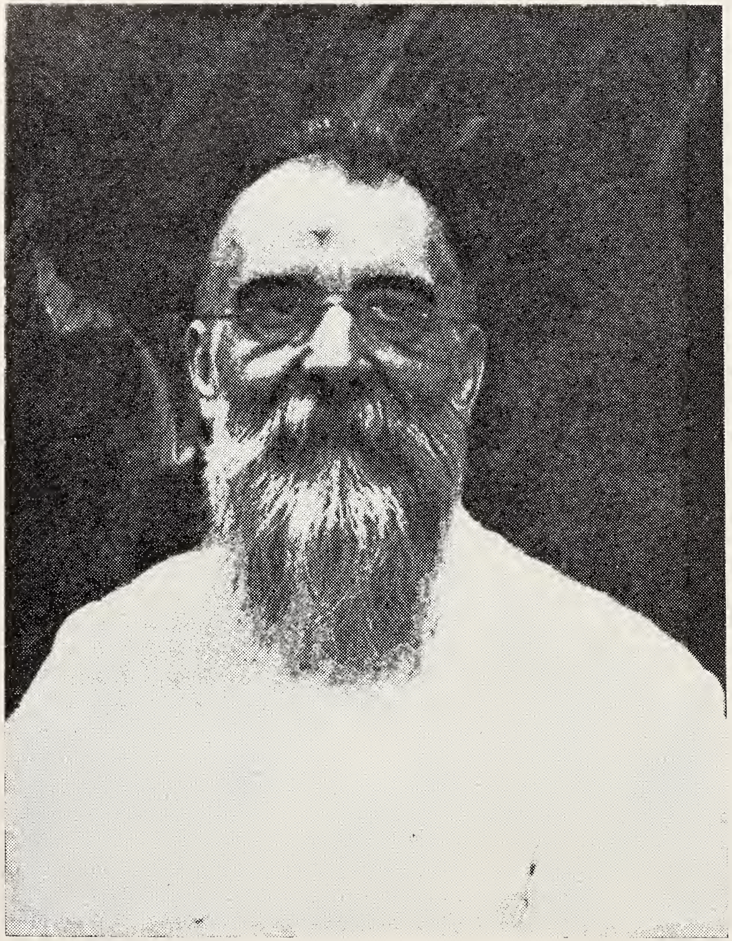
HUGH WHISTLER 1889-1943 (Vol. 44:289) by N. B. K(innear).

Born in Lincolnshire on 28 September 1889; died July 1943. Came out to India in the Imperial Police Service and was assigned to the Punjab. During the 16 odd years prior to his premature retirement he served for varying tenures in almost every district of the Province, and being a dedicated student of birds he made the best of his opportunities to amass a comprehensive collection of bird skins and in the process to acquire unsurpassed knowledge of the avifauna, not only of Punjab but also of neighbouring Kashmir and N.W.F.P. He kept meticulous notes on the birdlife wherever his duties or pleasure took him and his districtwise reports on Punjab birds, published from time to time in *The Ibis* or in *JBNHS* bear witness to his thoroughness and scientific acumen. A friendship struck up with Dr. C. B. Ticehurst while the latter was serving in the RAMC at Karachi in the 1st World War when Whistler was stationed at Rawalpindi, and the introduction to systematic ornithology and guidance he received from Ticehurst helped to develop him into an expert ornithologist.

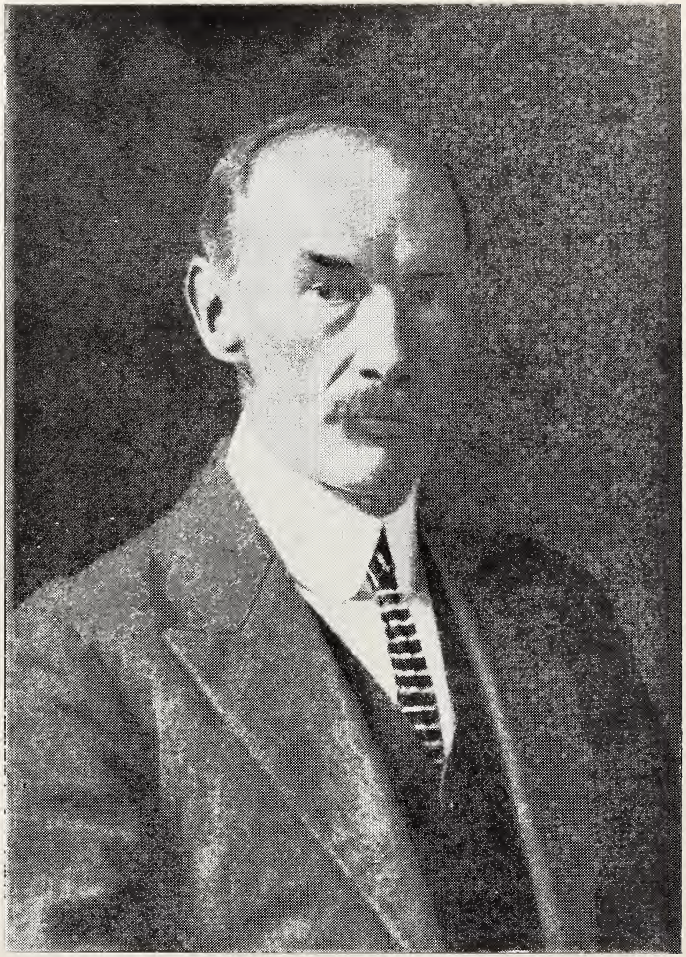
Shortly after the First World War Whistler was approached by Mr. Millard and two other old members of BNHS to undertake the authorship of a popular illustrated work on Indian birds. No happier selection could have been made since Whistler, had the requisite knowledge with a pleasing literary style. The success of the book—POPULAR HANDBOOK OF INDIAN BIRDS — is shown by the fact that it has now passed through 4 editions. When the Society undertook the Survey of the Eastern Ghats in 1923, Whistler who had meanwhile settled down at Battle in U.K. was asked to work out the collections jointly with Dr. Claud Ticehurst and Mr. N. B. (later Sir Norman) Kinnear. He threw himself wholeheartedly into the work with the result that his paper in 16 parts published in *JBNHS* Vols. 34-39 became practically a review of the birds of the Peninsula. He also worked out the bird collections made by the various subsequent regional Surveys.

Ticehurst and Whistler had jointly begun to write a Handbook of Indian Birds to replace the second edition of the Fauna by Stuart Baker which had several obvious shortcomings. After the death of Ticehurst, Whistler had hoped to complete the book by himself but unfortunately did not live to finish it. By courtesy of the British Museum (Nat. Hist.), the legatees, his meticulous MS notes have

Hugh Whistler
(1889-1943)



Father Jean Ferdinand Caius, S.J.
(1877-1944)



Reginald Innes Pocock
(1863-1947)

been largely utilized by Sálim Ali and S. Dillon Ripley in their HANDBOOK OF THE BIRDS OF INDIA AND PAKISTAN.

Hugh Whistler was a perfectionist; painstaking, punctilious, and phenomenally industrious, and he had no use for the careless observer or slipshod worker. He was always ready to help brother ornithologists, whether a beginner or a seasoned colleague. In his civic life in Battle, where he was Vice Chairman of the Rural District Council, it was the same: he was consulted by every one and was greatly respected by his large number of friends and fellow councillors.

FR. JEAN FERDINAND CAIUS, S. J. 1877-1944 (Vols. 45:79—photo) by S.H.P(rater).

Born in France 17 January: died at Bombay 27 July. "One of that distinguished company of Jesuits, men of great learning and science, who devoted their lives to service in India and who, passing, have left this country richer for their labours and poorer for their loss". On coming out to India in 1895 as a Scholastic in the Society of Jesus, he joined the Madura Mission and was subsequently attached to St. Joseph's College, Trichinopoly, where, among other things, he started a Natural History Museum. Fr. Caius was Professor of Chemistry at St. Joseph's College, Trichy from 1911 to 1922 when he was transferred to Bombay as director of the Chemistry Dept. of St. Xavier's College. By 1924 he had established his reputation as a bio-chemist and was appointed by the Government of Bombay to take charge of the Pharmacological Laboratory of the Haffkine Institute where he worked until his retirement in 1932 at the age of 55. He was Chairman of the Committee of Trustees of the Natural History Section, Prince of Wales Museum of Western India, and Honorary Secretary of BNHS and one of the Editors of its journal between 1938 and 1944. His obituarist, who was the Curator of the Society at the time and in close and constant touch with him, records 'It was good to work with him. He brought to his work the acumen, the clarity of thought, and the critical mind of the true man of science that he was. But he also brought to it that human sympathy and understanding which endeared him to all who worked with him. In the field of science he was unable to suffer fools gladly. But in the field of charity his great heart got the better of him. For this he will be loved and remembered by us.'

One important contribution by Fr. Caius was his extensive studies of the poison apparatus of snakes, and of the remedies employed against snake poisons. In India he turned his attention to the investigation of the value of various remedies in the Ayurvedic and Unani systems of medicine supposed to be effective against snake bite. After long and laborious research he and his collaborators rendered great public service by demonstrating that these widely employed so-called remedies were completely ineffective against cobra and viper poisons. Fr. Caius was one of the leading authorities on the medicinal and poisonous plants of India, and students of indigenous drugs will be ever indebted to him for his revision of Kirtikar and Basu's out-of-print work on *Indian Medicinal Plants*. Another subject that interested Fr. Caius was "Earth-eating and Salt-licks". His chemical analyses of the salt-lick earth sent to him from various parts of India, published in the Society's Journal, should be of great relevance in the scientific management of wildlife reserves.

SIR ERNEST HOTSON, K.C.S.I., O.B.E. 1877-1944 (Vol. 45:80) by W.S.M(illard).

John Ernest Buttery Hotson. Born 17 March: died 12 May. Entered the Indian

Civil Service 1899, joined the Indian Army Reserve of Officers when World War I broke out and did military duty chiefly in Baluchistan from 1915 to 1918. He was a keen naturalist and for many years one of the Society's strongest supporters. When in Baluchistan, and also later in Persia, he collected specimens for the Mammal Survey of India which was started by BNHS, generously defraying half the expenses of the Society's field collector. Some of his specimens were considered exceptionally valuable by R.I. Pocock of the British Museum (Natural History) (who was handling the Mammal Survey material) because they had full particulars, localities, altitudes, dates, and measurements. 'I do not believe' Pocock wrote 'that Oorial, for example, have ever been properly measured before, sportsmen caring for nothing but the horns and shoulder height.' Sir Ernest presented a large collection of botanical specimens made by him in Baluchistan, Afghanistan and Persia to the late Fr. E. Blatter, S. J., which is now in the Blatter Herbarium, of St. Xavier's College, Bombay.

EDWARD CHARLES STUART BAKER, C.I.E., O.B.E. 1864-1944 (Vol. 45:212—photo) by N. B. K(innear).

Died 16 April. Following in the footsteps of his father E. B. Baker he joined the Indian (Imperial) Police in 1883 serving the first three years in Bengal and the rest of his tenure in Assam. Stuart Baker joined the Society in 1898 and his first bird paper 'On the genus *Chloropsis*' appeared in Vol. 6 of JBNHS in 1891 followed by many other contributions from time to time. But it will be for his beautifully illustrated popular serials on ducks and other sporting birds that Baker will be best remembered. These articles helped to boost the Society and popularize the Journal among sportsmen and naturalists throughout the country and beyond more than anything else. 'The value of Mr. Baker's papers in popularizing the Journal' his obituarist pertinently remarks 'must never be forgotten'. They were later published in book form, and the success of the first volume on *Indian Ducks and their Allies* emboldened the Society to launch out cautiously on its natural history book publication ventures which have proved so profitable in the long run. During his long service in Bengal and Assam Baker made a large and scientifically invaluable collection of bird skins in remote parts of the country then almost unknown ornithologically, and of many rare and interesting species. Besides, skins he assembled a huge collection of birds' eggs in general and those of the parasitic cuckoos and their hosts in particular. Studying the habits of parasitic cuckoos was his special interest and his book *Cuckoo Problems* is an epitome of these researches. The eggs were collected partly by himself and partly by hired local tribals and his numerous correspondents all over the Indian subcontinent. He relied perhaps rather too trustingly on the information supplied by his collectors, not always dependable, and this led to errors in his publications detected long after his death on a critical reexamination of his egg collection, a large part of which has found its way to the British Museum (Natural History). Based on his own studies and those of other zoologists before him, Baker wrote his comprehensive 4-volume *Nidification of Birds of the Indian Empire* (1932-35) which, despite obvious shortcomings, is still the most complete reference work available on the subject. Baker retired in 1911 as Inspector-General of Police for Eastern Bengal and Assam and returned to England to assume charge of the Port of London Police, which he reorganised and brought up to a high standard of efficiency before his final retirement in 1925. Mr. Baker had plenty of time to devote to ornithology after he returned to live in London; in 1913 he was elected Secretary and Treasurer of the British Ornithologists' Union, which office he held till 1923.

Mr. Baker was a great shikari and a good rifle shot. He wrote interesting accounts of his experiences with big game in the Journal and other sporting magazines. He was twice tossed by a gaur and trampled on by a rhinoceros, and had lost his left arm in an encounter with a man-eating leopard in Silchar. He was following the animal which had taken refuge in a native hut, when it charged and knocked the rifle out of his hand. The leopard seized him, and to save himself he thrust his left arm down the beast's throat. Luckily his shikaris came to his assistance and despatched the animal. Despite the loss of one arm he continued to shoot both with shot-gun and rifle. Mr. Baker was an excellent tennis player and a keen rider, and had won numerous championships in either sport. With his single hand he was extraordinarily clever, and it was wonderful to see him place a small egg in a box of sand and inscribe it.

Some of his contemporary and succeeding ornithologists have often been less than charitable to Stuart Baker, accusing him (not always unjustly !) of dubious practices in his ornithological work. Indian ornithology, nevertheless, is deeply indebted to him for the rich legacy of bird lore he has left behind.

REGINALD INNES POCOCK, F.R.S., 1863-1947 (Vol. 47: 360—photo) by N.B. K(innear).

Born March 4: died August 8. On completion of his zoological studies at Oxford and Bristol he was appointed in 1885 to the staff of the British Museum (Natural History) and given charge of the Arachnida and Myriopoda. One of his first contributions dealing with the Indian Region was on the Myriopoda of the Mergui Archipelago in 1887. In 1895 he contributed to JBNHS an account of the Galeodidae inhabiting India and Ceylon. This marked the beginning of Pocock's long connection with the Society. He was specially interested in scorpions at the time and as a result of his appeal through H.M. Phipson for specimens to members of the Society large numbers of scorpions, alive or dead, were received in the Society's rooms, among them several new species which Pocock described in the Journal in 1897. He wrote the volume on Scorpions in the Fauna of British India series in 1901. Pocock retired from the British Museum soon after and was appointed Superintendent of the Zoological Society's Gardens in 1904. At the Zoological Gardens he made full use of his opportunities to study live animals, especially his favourite groups—the monkeys, carnivora and ungulates. Among the live animals from India received by the Zoo from time to time there was a goral from Chamba which excited Pocock's special interest and induced him to study these animals and their allies, the serows. The result appeared in the Journal for 1910 under the title of "The Serows, Gorals and Takins of British India and the Straits Settlements". This was the forerunner of the long series of papers on mammals which he contributed to JBNHS. They resulted in arousing keen interest among members of the Society and in Pocock receiving many valuable notes on the habits and distribution of the various animals, which enabled him to undertake the authorship of the second edition of the Fauna of British India volumes on Mammals. The first volume dealing with monkeys and part of the Carnivora was published in 1939, and the second volume which completed the Carnivora, in 1941. The rest of the large animals—the ungulates and elephants—were planned to be covered in the third and final volume. Unfortunately Mr. Pocock died before he could complete the MSS for it. The new volumes are a great advance on the first edition. The systematic treatment is thoroughly updated and great pains have been taken to make the paragraphs on habits etc. more pleasantly readable, thus rendering the volumes indispensable to the systematist as well as to the sportsman and the field naturalist. Pocock's last contribution to JBNHS was one of a series he was publishing on the Wild Asses of Asia for which fresh material from the Rann of Kutch had been procured for him by the Society through the good offices of Maharao Vijayarajji of Kutch. The necessary specimens were collected by Mr. Sálim Ali who "afterwards wrote the first accurate account of the animal's habits".

A bibliography of Pocock's more important papers in JBNHS and other scientific periodicals between 1910 and 1936 follows the obituary in Vol. 47. As can be seen, his knowledge of natural history was not confined to spiders and mammals, but he also had a wide and general acquaintance with many other groups.

ALEXANDER EDWARD JONES, 1878-1947 (Vol. 47:363) by Sálim Ali.

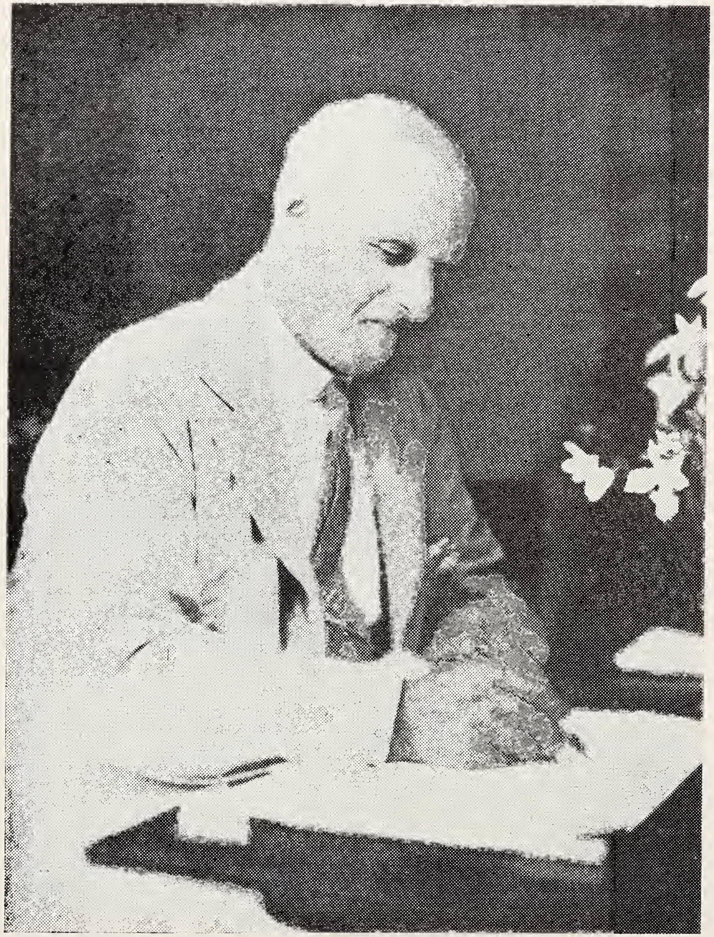
Died at Simla 17 October. Joined the Society in 1910 and was an active and useful member during his long association with it. He was an ardent and discriminating collector of birds and a very keen and knowledgeable field ornithologist whose notes and records have added substantially to our knowledge of Indian birds. Jones was the first ornithologist to record the occurrence of the Blackthroated Diver (*Gavia arctica*) in India in 1922, an observation not repeated since but a notable addition to the Indian avifauna. In 1944 Jones generously gifted to the Society his entire collection of some 3000 bird skins made in many parts of the subcontinent in over 30 years of residence in the country. Most of the specimens were shot and prepared by him personally and the excellence of their make-up and labelling adds immensely to their scientific value. Jones was a reliable observer with a contagious enthusiasm for bird watching. He had acquired an extensive knowledge of Indian birds in general, and particularly of the birds of his 'native' western Himalayas. For this area he was recognized as an authority and consulted even by such contemporaries as Stuart Baker and Hugh Whistler. Though a tailor and cutter by profession, and owner of a flourishing tailoring establishment at Simla, he missed no opportunity of indulging in his favourite hobby. His interest, however, was not confined to birds alone; he was deeply interested also in plants and insects, especially butterflies, and has made important contributions to our knowledge of Simla butterflies. Jones is described as a genial and lovable man whose sincerity and sympathetic help at all times endeared him to every young naturalist who came in contact with him.

A bibliography of Jones' more important papers published in JBNHS follows his obituary in Vol. 47.

H. H. SHRI VIJAYARAJJI, MAHARAO OF KUTCH, 1886-1948 (Vol. 47:530—photo) by Sálim Ali.

Died 28 February. Succeeded his long-lived father Khengarji as Maharao in 1942 at the age of 57, and during his short rule introduced a number of liberal reforms for the benefit of his subjects. In his younger days, before

His Highness Maharao Shri Vijayarajji of Kutch.
(1886-1948)



Charles McFarlane Inglis
(1870-1954)

Sunder Lal Hora
(1895-1955)

a knee injury partly crippled him, he was a fine all-round sportsman—an excellent rider and tennis player, and an outstanding performer with shot gun and rifle. Indeed his prowess with the shot gun had become a byword among his confreres, and though prevented from indulging in his passion for small game shooting as vigorously as before, he nevertheless retained his expertness as a bird shot to the end. Though a keen all-round naturalist, his special interest was birds, and soon after assuming power he sponsored a thorough field survey of the regional avifauna and encouraged the publication of a popular colour-illustrated book of the birds of Kutch based on the results.

Maharao Vijayarajji's knowledge of the birdlife of his State, particularly of the game birds, gathered over a lifetime of discriminating sport and field observation was extensive. He wrote little, but fortunately some of the vast store of information he possessed has found permanent record in *The Birds of Kutch* by Sálim Ali which will stand as a fitting memorial to the deep interest he took in his native birds.

Vijayarajji joined BNHS as an ordinary member in 1920. He was elected a Vice Patron in 1943 by virtue of his numerous benefactions to the Society and the keen interest he always took in its affairs and welfare during his long association with it.

BRIGADIER GENERAL REGINALD GEORGE BURTON, 1864-1951 (Vol. 49:763) by R. W. B(urton).

Died 2 February, in his 87th year. Fourth son of the late General E. F. Burton of the Madras Staff Corps all of whose nine sons followed their father's profession. He was commissioned in August 1884 and after a period of service in Jamaica came to India and was appointed to the Bengal Staff Corps and the Hyderabad Contingent. He retired from the Army in 1918 and after some stints in civil employment in U.K. settled down in Gloucestershire. Brig. Burton joined BNHS in 1898 and contributed many interesting notes and articles on shikar and natural history topics to the Journal. He had inherited both sporting and literary tastes; his History of the Hyderabad Contingent is a masterpiece of its kind, and among other things gives vivid vignettes of the wildlife of the Deccan of those days. Besides numerous publications on military history and historical works on Indian campaigns, he wrote some fascinating and highly informative books on shikar and wild life in India including SPORT AND WILD LIFE IN THE DECCAN (1928), and A BOOK OF MAN-EATERS (1931), THE BOOK OF THE TIGER (1933), and THE TIGER HUNTERS (1936).

The class of sportsman-naturalist of whom Brig. Burton was a typical example has vanished from the Indian scene alas, and with their going wildlife has lost some of its most dedicated champions.

A.A. DUNBAR BRANDER (Vol. 51:926) by James W. Best.

Born and brought up at Lossiemouth in Scotland. One of the last of the great shikaris of the Indian Forest Service under the British administration. Entered the service after his studies at Cooper's Hill and in Germany. His entire service which extended from 1900 to 1921 was in the (then) Central Provinces where he took full advantage of his opportunities for sport whether big game hunting or wildfowl shooting or pigsticking, and soon became famous as a shikari. His knowledge and experience of wildlife was unmatched. During the whole of his service he was collecting material for his book on WILD ANIMALS

OF CENTRAL INDIA which is now a classic.

Brander was a most amusing and entertaining companion with a great sense of humour, and in spite of a pose of truculence he was one of the kindest of men.

SIR PETER CLUTTERBUCK, 1867-1951 (Vol. 52:563) by J. E. C(lutterbuck).

Died in England on 20 December at the age of 84. After his forestry training at Cooper's Hill for the Indian Forest Service he came out to India in 1887 and found himself posted to the Central Provinces. His first station was Chanda where he was lucky enough, as he said himself, to have as Conservator a man who told him that shikar was the only way to get to know the immense forests of that area which then were unmapped and without working plans. Shikar, his Conservator said, would take him miles off the beaten track and enable him to get to learn his territory as no other method could. He plunged wholeheartedly into this new life with an enthusiasm and zest that never left him. He was a man of tremendous physical strength and on occasions in his early years he would spend days and nights continuously with his Gond trackers following a bison or buffalo to study its habits: where it fed and what it fed on and where it drank and slept, etc. He prepared his first working plans of Chanda and it was here that he made his legendary walk of 64 miles in 16 hours solidly through the night when he got news that a man-eating tiger was interfering with his fire protection staff and keeping them away from guarding the most valuable teak forests at Allapili from fire. In U.P., where he was transferred shortly afterwards, the forests were heavier, more developed and richer. But they were no less rich in game than the C.P. There were elephants for forest work and inspection tours which was not the case in the C.P. His wife was his constant companion and went with him into camp in October, not returning to their station till the following rains. In the hot weather they used to march early and his invariable orders to the mahouts for the next morning were *"Hathi char bajay"* (Elephants at 4 a.m.). 'This later became a family saying for any early start'.

His interest in big game hunting gradually waned: he gave up his rifle and took to field glasses and bird watching. In his last 34 years bird watching and fishing became his greatest interests outside his work and home. A walk with him from place to place in the hills was not along the contours or bridle path but straight down the khud and up again in a bee line. At the seniority of Inspector General of Forests he could outwalk and outstay men of half his age.

In 1932, seven years after returning to England after 40 years' service in India, the English climate and an invitation from his friend the Maharao of Kutch brought him back to India and he later accepted the post of Chief Conservator of Forests, Kashmir. And in the next 13 years prior to final retirement in 1945 he worked wonders in reorganising and developing the Forest Department of that State. All who knew him will agree that Sir Peter was a most remarkable man. Not only had he exceptional abilities in the wide variety of activities of a forest officer's calling, but he was an administrator of great vision and tremendous faith. He was a keen and observant shikari and naturalist, a dedicated animal and bird lover and an unusually knowledgeable botanist. In fact it was his love of animals and birds and natural history that had initially brought him to India.

CHARLES MCFARLANE INGLIS, 1870-1954 (Vol. 52:565—photo) by Page.

Born in Scotland 8 November; died at Coonoor (Nilgiris) 13 February. When about 19 he came away to India from an office job in Inverness and luckily found congenial vocation as an assistant on the Roopachera Tea Estate in the Hailakandi district of Cachar in January 1889. The journey to Cachar in those days was a rather long one, partly by boat and partly by river steamer. Roopachera was an ideal spot for any one interested in natural history as there was heavy forest on its boundaries, and it was all new and exciting for the young naturalist. He spent his Saturday afternoons and Sundays in the forest, sleeping on a low machan beside some forest stream. At that time Stuart Baker was working in the North Cachar hills: Charles soon got in touch with him and then began a friendship that lasted for the rest of SB's life to the mutual benefit of both as well as of Indian ornithology. With the help of one of Hume's Indian collectors, jobless after Hume had given up bird collecting, Inglis contributed a great deal of the material, both specimens and notes, which later helped SB in writing the second edition of the FBI volumes on birds. In 1898, by which time he had given up tea, he moved to a job in indigo planting(?) at Baghowni in Bihar where he lived for 25 years, having bought up the place in 1900. He made very complete collections of birds, butterflies, moths, and dragonflies while in Bihar and had many outdoor aviaries where he bred Burmese peafowl and swamp partridges, and where a pair of green woodquail laid the first known eggs of that bird in one of his aviaries. Besides natural history his other hobbies were gardening and painting; he often took his painting materials with him on his treks to paint any interesting bird collected. In 1923 Inglis took over as Curator of the Darjeeling Natural History Museum which was in a state of decay. He had to reorganise it and start a Society and journal which he did well enough to elicit praise from museum experts who came from England in 1935-36, to survey Indian museums. To the end he contributed regularly to the Journal of Darjeeling (later Bengal) Natural History Society, of which he had been editor for 25 years. Inglis also co-authored the book BIRDS OF AN INDIAN GARDEN with Bainbrigge Fletcher. After retirement he settled in a cottage in Coonoor on the Nilgiri hills, where he lived till his death at the age of 84.

SUNDER LAL HORA 1895-1955 (Vol. 53: 445—photo) by S. C. Law.

Died 8 December. Began his research career at the age of 22, joined the Zoological Survey of India as a research scholar in 1919, and was appointed an Assistant Superintendent in 1921. In 1922 he earned a D. Sc. from Punjab University for his work on fish and fisheries of India; and in 1928 he secured a D. Sc. from Edinburgh University for his studies on the ecology, bionomics and evolution of torrential fauna with special reference to the organs of attachment. From 1942-1947 he was Director of Fisheries of undivided Bengal, after which he rejoined Zoological Survey of India as its Director, a post he held till his death. His primary interest was Ichthyology, and he was best known as an ichthyologist. In all he published over 400 papers in various foreign and Indian scientific journals including JBNHS—a prodigious number for any man. He enunciated what came to be well known as Hora's Satpura Hypothesis which attempts to explain the presence of Malayan elements in the fauna of Peninsular India. His work on the pond culture of fishes evoked worldwide interest, and in 1949 the United Nations Organisation invited him to open a discussion on "Pond culture of warm water fishes" at Lake Success. He also contributed significantly to our knowledge of the biology of the Indian Shad, *Hilsa,* and in 1952 was the Chairman of the *Hilsa* Sub-Committee of the Indo-Pacific Fisheries Council. SLH had a deep-rooted interest in nature and conservation of wildlife and was the first honorary Secretary-General of the Indian Board for Wildlife created in 1952. He was also extremely interested in the scientific knowledge possessed by ancient Hindus as revealed in Sanskrit literature, and in archaeological relics such as the edicts of Asoka and potteries of Mohenjo-Daro and Harappa. On this topic he managed to generate considerable interest during the course of his talks in the Indian Museum and the Asiatic Society, Bengal. SLH was on the Advisory Committee of Bombay Natural History Society since 1945, and always took an active and lively interest in all the doings and welfare of the Society, readily giving valuable advice and suggestions, which were frequently sought. He was a man with a great mind and generous heart; it was characteristic of him that, whether in scientific circles or in private life, he laid his vast store of knowledge and experience at the disposal of all who cared to seek it. He also worked tirelessly and it is believed by many of his friends that it was this overwork which told on his health; he suffered his second attack of coronary thrombosis while presiding over a meeting of the Asiatic Society of Bengal, Calcutta, and passed away peacefully three days later.

BRIGADIER W.H. EVANS, C.S.I., C.I.E., D.S.O., R.E., 1876-1956 (Vol. 54:440) by K.C. (Keith Cantlie).

Born in Assam; died November. By profession he was an engineer and served with the Royal Engineers in the Somaliland Field Force in 1903-1904, and in France in the 1914-1918 War. In 1927 he became the Chief Engineer, Western Command, and in 1931 retired from service. He was an extremely keen entomologist and though his only extensive collecting trips were five months in Burma in 1920-21 and two months in Sikkim in 1906, he contributed very significantly to this study. His major work was the Keys he constructed for identification of the different species, and subspecies, of Hesperiidae, based on the difference in the genitalia. His Keys have formed the basis of the Keys of Talbot in the volumes of 1939 and 1947 of his revision of part of Bingham's *Butterflies of India, Ceylon and Burma* in the Fauna of India series. His serial article in the Journal of Bombay Natural History Society on the Identification of Indian Butterflies was published in book form in 1927, and a second edition in 1932 with many corrections and additions. After retirement he worked as an Honorary Associate at the British Museum (Natural History). Here he devoted himself entirely to the Hesperiidae of the World, bringing out volumes entitled 'Catalogue of the Hesperiidae in the British Museum (Natural History)'. This is a monumental work with the volume on Europe, Asia and Australia alone comprising of 502 pages, the information on the species given in the most economical terms. Since his first article in 1912, he kept contributing to the Journal of Bombay Natural History Society till his last few years. In spite of poor and failing health he managed to work with immense concentration and steadiness of hand and vision. To the end he continued doing original work, always ready to put it aside to help anyone with the identification of the butterflies they brought, or to talk of his happy days in India.

ARTHUR ST. JOHN MACDONALD 1898-1956 (Vol. 55: 142) by J. M. Bannerman.

Born in Multan, Punjab on 8th November 1898; died on 6th December 1956. He was educated mainly in Naini Tal at St. Joseph's College. In 1917 he joined an indigo concern in Bihar. Soon after, in 1918 he got his commission in the Indian Army and served for a while in Mesopotamia, and later in the 1919 Frontier War. This was a temporary commission after which he joined the sugar estates of Messrs Begg, Sutherland and Co. at Purtabpore. In 1925 he left for Burma where he joined Messrs Finlay Fleming and Co. and was employed in the Shan States in the work of clearing jungles for sugarcane cultivation. It was the years in Burma that helped to develop AM into a keen naturalist. He acquired an extraordinary store of knowledge of the jungle and natural history for which he has sometimes been compared to Jim Corbett. He also acquired and indulged in a passion for fishing and shooting. After many interesting years in Burma, AM returned to sugar in Bihar for a while and left again to become the manager of a zaminary in Basti district, Uttar Pradesh, near the Nepal border. Here he continued his hobbies as a naturalist, and also bred gun dogs. During the Second World War, he served in the Army with distinction, and at the end of the War left it as a Lt. Colonel. In 1948 he returned to sugar once more and joined Begg, Sutherland and Co. for the third time. Most of his holidays were spent in the Himalayan foothills, Kumaon hills and Kashmir, where he would spend almost all his time fishing and shooting. He wrote many extremely interesting articles on fishing, shooting and jungle life in various Indian and foreign periodicals. His long series on mahseer fishing in the Journal of Bombay Natural History Society was published by the Society in book form as CIRCUMVENTING THE MAHSEER AND OTHER SPORTING FISH IN INDIA AND BURMA, and proved to be very popular with Indian anglers.

LT. COL. E. G. PHYTHIAN-ADAMS, O.B.E., F.Z.S., 1883-1959 (Vol. 56:293) by Brig. S. T. Apcar.

Born August 1883; died 9 February 1959. Came out to India in 1904 initially with the South Wales Borderers, then was transferred to the Madras Regiment. During World War I he saw service with his regiment in Mesopotamia. He retired in 1924, but volunteered his services at the outbreak of the Second World War, during which period he was awarded the O.B.E. In 1945 he retired for the second time, and settled down in Kalhatty, a few miles from Ootacamund. Lt. Col. Phythian-Adams was a 'born naturalist-sportsman'. His trophy room was impressive and often visited by admirers. In a series of articles, "Jungle Memories" published in the Journal of Bombay Natural History Society [Vols. 48(1) to 50(3)], he gives a fascinating account of his numerous shikars. It was the dangerous excitement of hunting big game on foot that thrilled him, and he deplored the unsporting ways of those who killed an animal startled by the glare of a car's headlights, or hunted regardless of sex or season. Besides being a distinguished soldier and fine sportsman, Lt. Col. Phythian-Adams also collected stamps, coins, medals, butterflies and birds' eggs. On regimental history he compiled the books, THE MADRAS INFANTRY, THE MADRAS SOLDIER and THE MADRAS REGIMENT. He first joined the Bombay Natural History Society in 1909, and was a member of the Advisory Committee for many years and up to his death. During his later life, when he stopped active shikar, it became his desire to share with others the experiences, knowledge and happiness which he had obtained from the jungle—an object well-accomplished through the "Jungle Memories". For the last twelve months he suffered from a weak heart and finally succumbed in a Mysore hospital on 9th February at the age of 75½.

(*To be continued*)

SOME OBSERVATIONS ON DOL (BAG) NET FISHERY AT SASSOON DOCK, BOMBAY[1]

S. Krishna Pillai[2]

(*With four text-figures*)

The paper describes the species composition of the Dol (Bag) net catches at Sassoon Dock, a major landing centre in Bombay, from January to December, 1971, grouping them into two main categories, those occurring throughout the year and the those having seasonal occurrence and then reclassifying them into market categories. The estimated dol net catches fluctuated between 275 and 1485 tonnes during the year. The monthly average catch was 829.5 tonnes which formed 41.6% of the total landings. A list of 33 species caught in Dol net and their percentage composition is given.

INTRODUCTION

The Dol net is an important gear used in Bombay-Gujarat coasts, mainly for catching Bombay duck, *Harpodon nehereus,* third in importance in respect of marine fish landing in India and non-penaeid prawns like *Acetes indicus, Palaemon tunuipes* and *Hippolysmata ensirostris.* The Bombay duck forms 14.10% and 20.85% of the total catch of Maharashtra and Gujarat states respectively, while the non-penaeid prawns form 58.35% and 4.50% of the total prawn catches of the above states respectively. (C.M.F.R.I. Annual Report, 1976). The operation of the 'Dol' net has been described by Pillai (1948), Hornell (1950), Setna (1954) and Gokhale (1957).

Gokhale (1957) mentioned that *H. nehereus* was taken along with *Coilia dussumieri,* species of *Penaeus* and *Metapenaeus,* immature *Stromateus cinereus, Trichiurus savala* and a few other less important species in Saurashtra waters. Chowdhury (1970) estimated the landings of

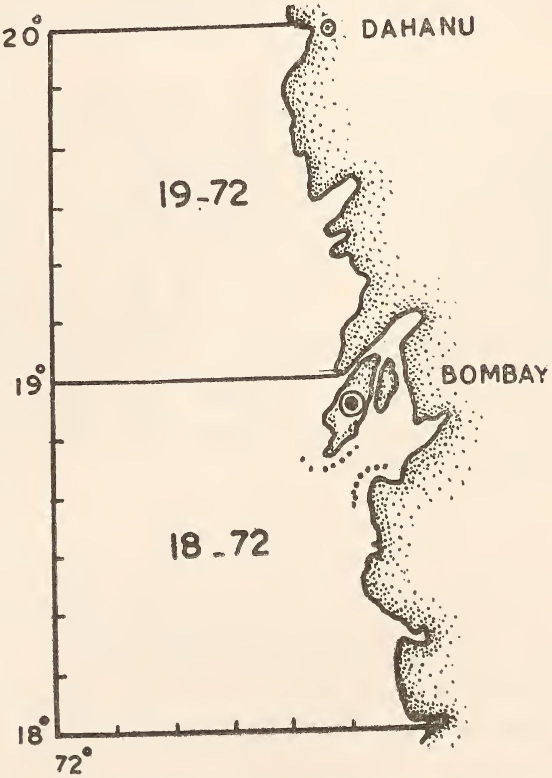


Fig. 1. Map of Bombay harbour, Sassoon dock showing the nearshore Dol net fishing grounds.

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fish at Sassoon Dock for a period of two months only. Apart from this there is no detailed published account of the 'Dol' net catches. The present paper deals with the catch composition of the fish caught by 'dol' nets operated between 15 to 20 km. from Bombay harbour and landed at Sassoon Dock from January to December, 1971. These observations formed part of the work of the survey programme for resources assessment.

Sassoon Dock, situated in South Bombay, is one of the biggest fish landing centres (Fig. 1). Though the landing takes place round the clock, the activities have two peak periods, once in the morning between 0.6.00 to 0.8.00 hrs. and again in the afternoon from 13.00 to 15.00 hrs. Apart from Bombay based boats, from Karanja and Uran also land their catches at Sassoon Dock.

Material and Methods

According to the survey programme, 10 to 12 observations of 6 hours duration each were made at Sassoon Dock every month. Data were collected from 12.00 to 18.00 hrs. on the first day and 0.6.00 to 12.00 hrs. on the following day. The night landings were recorded after enquiry. Catches of each type of selected units were examined in detail to determine the species composition of the catch and their weight. The total catch and catch composition of species were estimated based on the average catch of unit. Stratified Random sampling method adopted by Fishery Resources Assessment Division of C.M.F.R.I. was used for the estimation of the total landing as given below.

$$\frac{\text{Total landing for the observed units} \quad \text{X} \quad \begin{matrix}\text{Total No. of units landed}\\ \text{during the observation period}\end{matrix}}{\text{No. of units observed}}$$

The estimate of catch for a day was obtained by adding the estimates for the forenoon (0.6.00-12.00 hrs), afternoon (12.00-18.00 hrs) and night landings. The estimate for the month was obtained by the formula given below.

$$\frac{\begin{matrix}\text{Total of the estimated landing}\\ \text{for the number of observed days}\end{matrix} \quad \text{X} \quad \begin{matrix}\text{No. of landing days}\\ \text{in the month}\end{matrix}}{\text{No. of observed days}}$$

Gear and Craft

The Bag net locally known as 'Dol' is lowered and hauled depending upon the turn of the tides. A strong tidal current is very essential for the proper operation of the net. The mouth of the net is always in the direction of the tide and the bag net functions as a filter to retain the fish. The strong tidal current prevents the fish from escaping from the bag net (Bapat 1970).

Two types of boats are used at Sassoon Dock, mechanised and non-mechanised. The non-mechanised boats are further divided into canoes and said boats. The mechanised boats are of Machva type, Satpati type and Bassein type. They are propelled by diesel engines of 25 to 30 H.P. They save considerable time in going to the fishing grounds and back and can take advantage of 2-3 tides. In Sassoon Dock, 98% of the mechanised boats are used for 'Dol' net operation.

RESULTS

Catches from 997 boats were examined for estimating the total catch, catch composition and weight of different species. Table 1 gives the number of observations per month, total number of dol nets observed with their percentage, the estimated total landings of dol net and the other types of units operated.

TABLE 1

MONTHWISE ESTIMATED DOL (BAG) NET CATCH OF SASSOON DOCK FOR THE YEAR 1971

Year 1971	No. of days of observation (24.00 hrs)	Total number of Dol units during the period of observation	Total number of Dol units observed	Percentage of Dol units observed	Monthly estimated total catch of Dol and other units (in tonnes)				
					Dol net catch	Percentage of the Dol units	Trawl catch	Dalti or Gill net catch	Hook and Lines
January	5	363	92	25.3	719.587	40.2	792.400	174.948	101.368
February	4	189	53	28.0	343.686	26.7	671.988	202.293	68.915
March	5	341	116	34.0	632.620	38.8	867.538	95.038	34.148
April	4	271	78	28.8	495.145	32.2	879.669	100.012	60.862
May	4	274	58	21.1	1381.987	46.9	1447.808	101.212	17.077
June	5	295	55	18.7	275.347	53.6	189.888	30.359	17.669
July	6	1061	121	11.4	1485.006	81.3	311.316	16.686	14.136
August	6	1019	135	13.2	1281.349	69.4	451.153	89.571	23.503
September	6	604	75	12.4	1126.085	47.2	1185.665	64.110	8.955
October	6	422	72	17.1	855.498	25.6	2065.193	365.530	49.296
November	6	474	80	16.8	787.750	25.4	2076.260	174.010	59.520
December	6	269	62	23.0	569.994	32.8	1008.514	69.809	88.145
Total			997		9954.054		11947.392	1483.578	543.594

It is seen from the table No. 1 the estimated total catch for the year 1971 amounted to 23928.618 tonnes of which 9954.054 tonnes (41.6%) were contributed by dol nets, 11947.392 tonnes (49.9%) by trawl nets, 1483.578 tonnes (6.2%) by Daldi or gill nets and 543.594 tonnes (2.3%) by hook and lines. A marked monthly fluctuation is seen during January-June and in August-December the catch shows a declining trend, the maximum being in July (Fig. 2). In July, the fishing operations were maximum (80.2%) and the highest catch of 1485 tonnes were landed, with *H. nehereus* contributing to 69.4% of the total catch.

The monthly landings of dol net in Sassoon Dock fluctuated between 275.347 tonnes (June) to 1485.006 tonnes (July) with an average of 829.5 tonnes (Fig. 2). During the monsoon months, Dol net catches showed an increase for the following reasons:

1. Number of 'Dol' units in operation during the monsoon months were considerably more as boats of nearby fishing villages also operated near Bombay harbour which is a protected area.

2. The landing of *H. nehereus* was higher

in July, August and September (1031.8, 944.2 and 911.7 tonnes).

3. *Palaemon tunuipes* was caught in large quantities in the months of May, July and August the catch being 646.3, 54.0 and 66.4 tonnes respectively. The share of *Hippolysmata* sp. was quite high in the months of May, August and September (11.9, 16.4 and 10.4 tonnes. table No. 3).

The quarterwise catch composition of fish caught in Dol net is given in Table 2. *H. nehereus* and non-penaeid prawns together

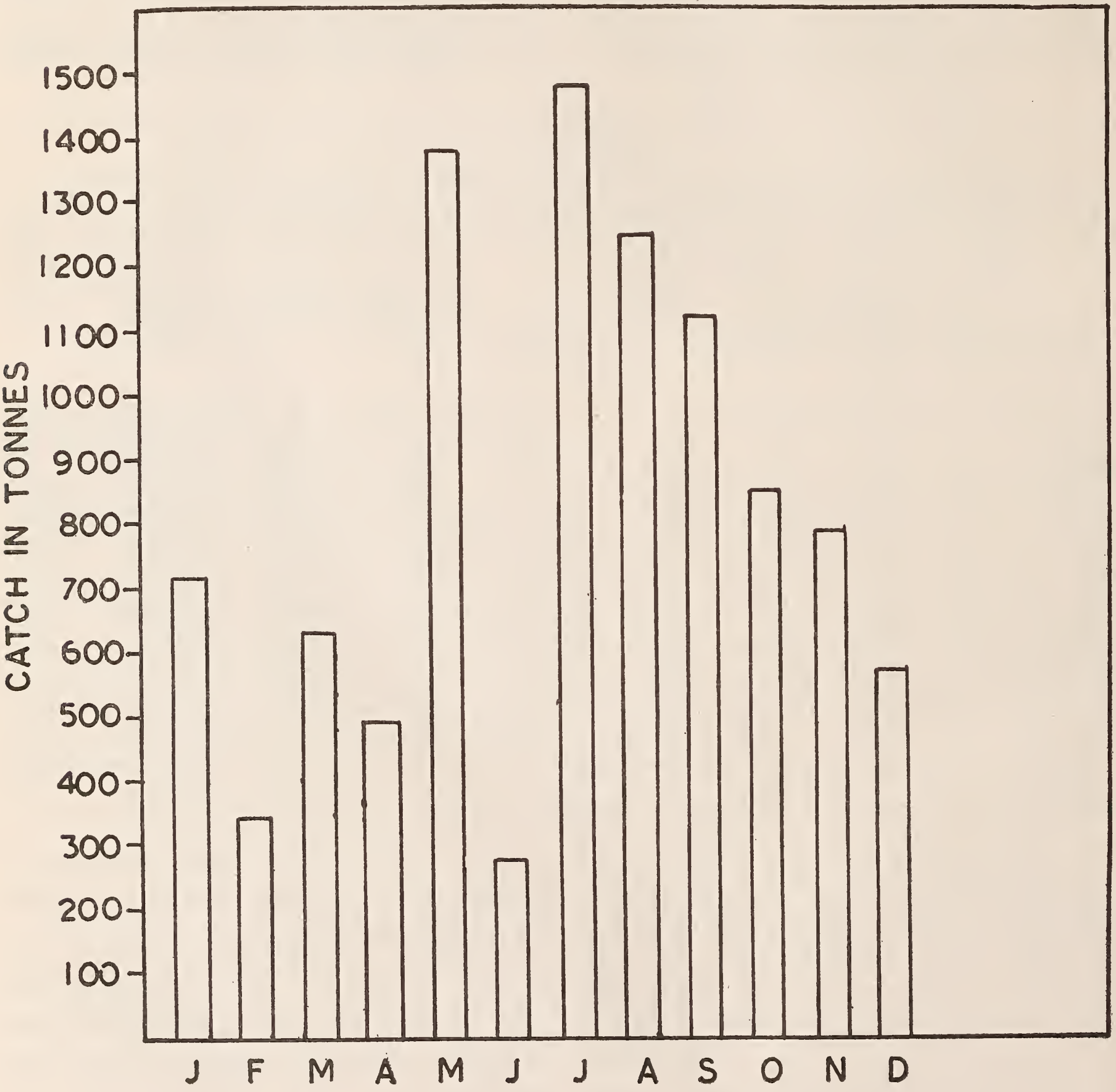

Fig. 2. Monthly fluctuations of fish caught in Dol (bag) net 1971.

TABLE 2

QUARTERWISE PERCENTAGE COMPOSITION AND LIST OF SPECIES CAUGHT IN DOL NET IN 1971

Sl. No.	Species	Jan.-Mar. Ist Quarter	Apr.-June IInd Quarter	July-Sept. IIIrd. Quarter	Oct.-Dec. IVth. Quarter	Yearly Composition
1.	Shark and Rays	0.52	0.37	0.36	0.30	0.39
2.	*Coilia dussumieri*	10.19	6.30	3.32	4.81	5.47
	Other clupeids					
3.	*Chirocentrus*	8.86	2.26	0.81	4.78	3.39
4.	Sardines, 5. *Hilsa toli*					
6.	*Thrissiocles*					
7.	*Dussumieria acuta*					
8.	*H. nehereus*	0.79	9.26	74.19	15.85	34.67
9.	Small sciaenids	1.63	2.05	0.63	2.66	1.57
10.	*P. sciaena*					
11.	*O. brunneus*					
12.	*P. hasta*	—	—	—	0.79	0.18
13.	*Trichiurus* spp.	2.08	2.90	1.21	7.68	3.17
14.	*Cybium* spp.	0.54	0.36	0.11	0.19	0.27
15.	*Stromateus* spp.	2.91	2.89	0.50	2.41	1.85
16.	*Bregmaceros* sp.	9.59	0.18	0.04	1.55	2.04
17.	*Arius* sp.	0.38	1.25	0.37	0.65	0.53
18.	*Lactarius lactarius*					
19.	*Caranx* sp.					
20.	*Cynoglossus* sp.					
21.	*M. cordyla*					
22.	*A. indicus*	56.01	32.05	10.79	51.26	32.09
23.	*P. tunuipes*	—	34.32	3.48	—	8.78
24.	*Hippolysmata* sp.	—	0.67	0.76	0.36	0.52
25.	Penaeid prawns	5.88	3.91	3.40	4.74	4.22
26.	*Solenocera indica*	0.23	0.26	0.02	0.23	0.16
27.	Cephalopods	0.10	0.06	—	1.26	0.31
	Other fishes					
28.	Eels	0.29	0.91	0.01	0.48	0.39
29.	*Upeneus* spp.					
30.	*Polynemus* spp.					
31.	Lobster					
32.	*Trypauchen vagina*					
33.	Miscellaneous					

contributed to 62.91%, 80.47%, 92.64% and 72.44% for the four quarters respectively.

In the first quarter, *A. indicus* dominated (56.01%) in the catch and penaeid prawn including *Solenocera indica* (0.23%) formed 6.11%. *H. nehereus* was caught in very small quantities (0.79%) which was compensated by significant increase of *Coilia dussumieri* (10.19%), other clupeids (8.86%) and *Bregmaceros* sp. (9.59%). The important species were *Stromateus* spp., *Trichiurus* spp. and Sciaenids accounting for 2.91, 2.08 and 1.63% respectively. The share of rest of the fishes is 1.83%.

In the second quarter, *H. nehereus* catch increased from 0.79 to 9.26% and *A. indicus* decreased from 56.01 to 32.05% and together formed 41.31% of the total catch. *P. tunuipes* showed an increase and ranked first 34.32%. The non-penaeid prawns *A. indicus, P. tunui-*

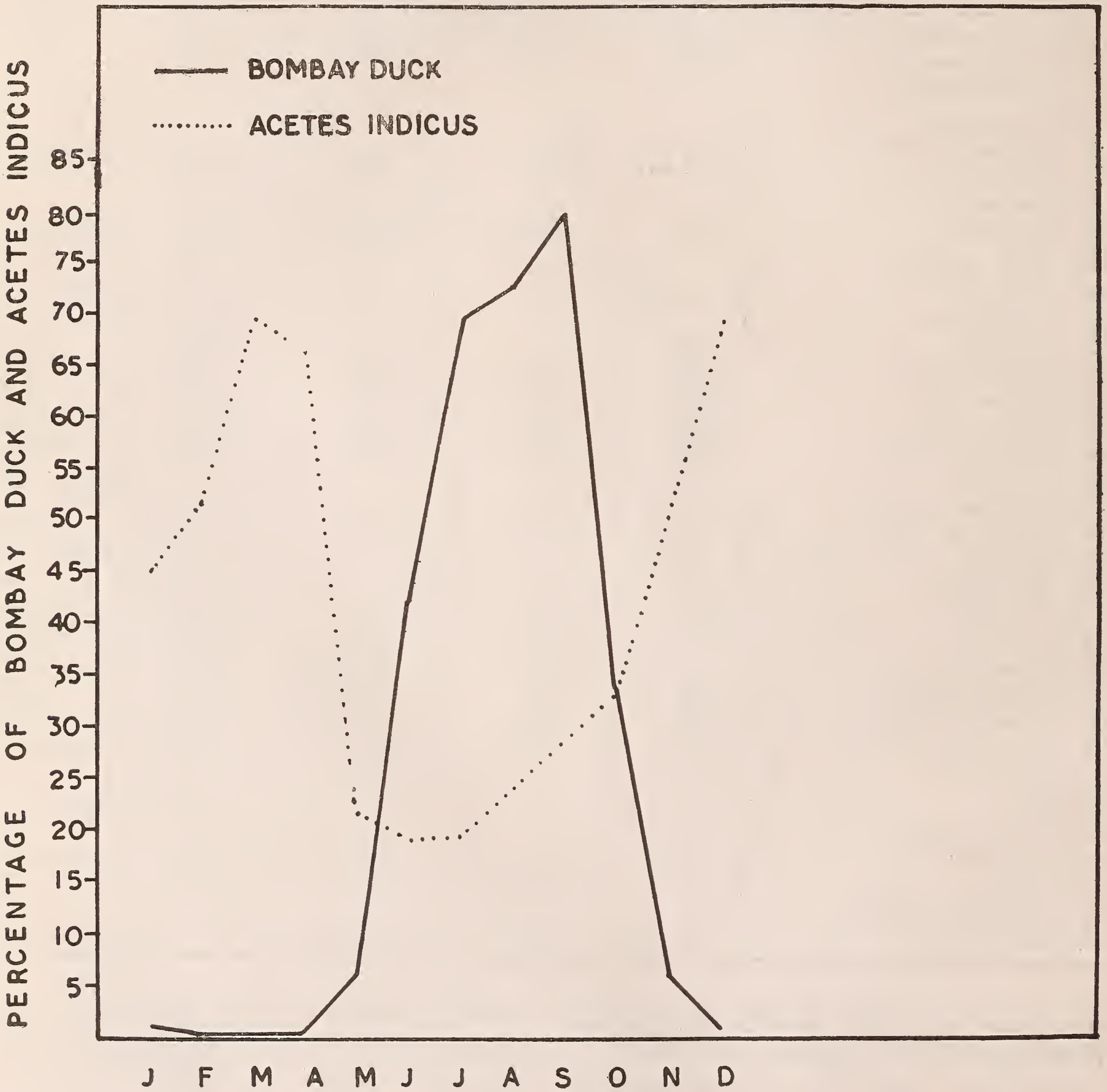

Fig. 3. The monthly percentage composition of Bombay duck and *Acetes indicus* in the Dol net catch at Sassoon dock, Bombay showing the inverse relationship.

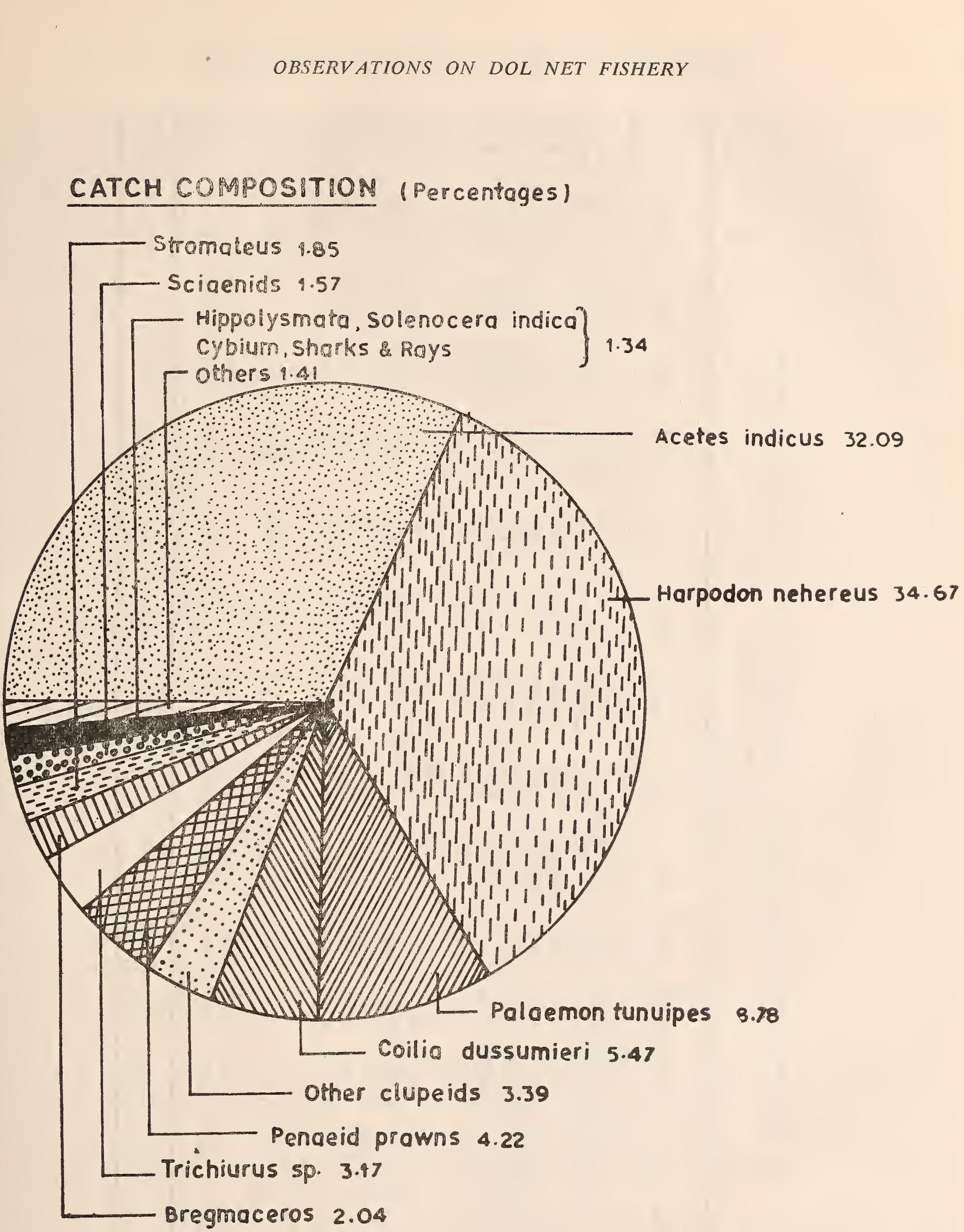
CATCH COMPOSITION (Percentages)
Stromateus 1.85
Sciaenids 1.57
Hippolysmata, Solenocera indica
Cybium, Sharks & Rays
1.34
Others 1.41
Acetes indicus 32.09
Harpodon nehereus 34.67
Palaemon tunuipes 8.78
Coilia dussumieri 5.47
Other clupeids 3.39
Penaeid prawns 4.22
Trichiurus sp. 3.17
Bregmaceros 2.04

Fig. 4.

TABLE 3

MONTHWISE SPECIES COMPOSITION OF FISH CAUGHT IN DOL (BAG) NET IN SASSOON DOCK FOR THE YEAR 1971 (CATCH IN KG)

Sl. No.	Species name	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total	%
1.	*H. nehereus*	8587	1330	3495	2767	79146	117480	1031814	944298	911705	291803	46980	12216	3451621	34.67
2.	*A. indicus*	326696	178633	444580	332145	304792	52980	287700	76575	55985	297879	408750	427950	3194665	32.09
3.	*P. tunuipes*	—	—	—	38962	646395	53442	54060	66440	15055	—	—	—	874354	8.78
4.	*C. dussumieri*	46301	75131	51496	28725	100770	6174	24888	47009	57560	36518	51700	18270	544542	5.47
5.	Other clupeids	105038	24409	20929	15337	26311	7079	9426	13111	9320	21607	57110	27270	336947	3.39
6.	Penaeid prawns	38656	18480	41650	18592	58163	7566	29778	82244	20585	33449	48580	22905	420648	4.22
7.	*Trichiurus* spp.	21582	5313	8497	26887	33285	2442	17274	13884	16235	103354	53510	13320	315583	3.17
8.	*Bregmaceros* sp.	137274	6937	18452	2820	1162	—	768	226	745	3224	9990	21150	202748	2.04
9.	*Stromateus* spp.	13869	12425	23119	9480	51150	1656	4314	2544	12610	15841	30440	7043	184491	1.85
10.	Sciaenids	12219	7574	7893	9900	29123	5166	9468	7549	7720	24149	24700	10171	155632	1.57
11.	Shark and rays	2653	3710	2452	1867	4538	1650	4398	5829	3970	3100	1530	2093	37790	0.39
12.	*Cybium* spp.				605	5992	180	3948	324	335	115	2090	2160	25962	0.27
13.	*Hippolysmata* sp.	—	—	—	705	11978	1824	2682	16469	10480	6975	825	270	52208	0.52
14.	*Solenocera indica*	—	574	3386	1440	2520	1704	—	803	—	—	4030	1148	15605	0.16
15.	Other Fishes	2676	7238	3426	3913	26662	16004	4488	4044	3780	17484	47515	4028	141258	1.41
		719587	343686	632620	495145	1381987	275347	1485006	1281349	1126085	855498	787750	569994	9954054	100

pes and *Hippolysmata ensirostris* together contributed 67.04%. Penaeid prawns including the *Solenocera indica* (0.26%) formed 4.17%. *C. dussumieri* and other clupeids together formed 8.56%. *Stromateus* spp. constituted 2.89%, *Trichiurus* spp. 2.90% Sciaenids 2.05% and remaining fishes 3.13%.

In the third quarter *H. nehereus* formed bulk of the catch 74.19% while *A. indicus* (10.79%), the other non-penaeid prawns *P. tunuipes* (3.48%) and *H. ensirostris* (0.76%) constituted 15.03%. The share of penaeid prawn including *S. indica* was 3.42%. *C. dussumieri* and other clupeids formed 4.13% and *Trichiurus* spp. 1.21%. The decline of *C. dussumieri* and *Bregmaceros* sp. in the third quarter may mainly due to the abundant of *H. nehereus* while the former formed the important food items of Bombay duck next to *A. indicus* (Bapat 1970). The share of the rest of the fishes is 2.02%.

In the fourth quarter *A. indicus* dominated (51.26%) in the catch. *H. nehereus* declined to 15.85%. The penaeid prawns including the *Solenocera indica* (0.23%) formed 4.97%. The landings of *C. dussumieri* increased from 3.32% to 4.81% and other clupeids from 0.81% to 4.78%. The share of *Trichiurus* spp. was very high (7.68%). Catches of *Bregmaceros* sp. increased from 0.04% to 1.55%. The contributions of sciaenids and *Stromateus* spp. formed 2.66 and 2.41% respectively. The cephalopods improved to 1.26% and rest of the fishes contributed 2.77%.

In the monthly 'Dol' net catch *H. nehereus* fluctuated between 0.4 to 81% and *A. indicus* between 5.0 to 75%. *H. nehereus* and *A. indicus* showed an inverse relation in the catch composition (Fig. 3). The possible explanation for this inverse relation may be the grazing by Bombay duck as *A. indicus* is one of the principal components of its food (Bapat 1970).

Among the different species, *H. nehereus* takes the first place in the 'Dol' net catch. The annual average composition was 34.67% (Fig. 4). July showed the highest monthly catch followed by August, September (Table 3) and caught throughout the year in the Dol net. *A. indicus* was next in importance (32.09%). It dominated during October to May with a maximum catch in March (444.5 tonnes). *P. tunuipes* was third in importance (8.78%) and was noticed in the catch from April to September. Among clupeids *C. dussumieri* occupied the first place and formed 5.47% of the Dol net catch. Other Clupeids like *Chirocentrus* spp., *Hilsa toli, Dussumieria acuta* and sardines together contributed 3.39%. Penaeid prawns occupied the fifth place forming 4.22% of the total catch and consists of *Metapenaeus brevicornis, P. sculptiles,* and *P. stylifera.* The ribbon fish took the sixth place and consists largely of juveniles of *T. haumela* and *T. savala* forming 3.17%. *Bregmaceros* sp. occupied the seventh place and formed 2.04% of the total catch, occurring throughout the year. Among the three species of *Stromateus, S. cinereus* was caught in large quantities. They generally consisted of juveniles forming 1.85%. Small sciaenids like *Johnius carutta, Johnius sina, Otolithus argenteus, O. ruber* and large one like *Pseudosciaena diacanthus* and *Otolithodies brunneus* together formed 1.57%. Sharks and rays (0.39%) and *Cybium* (0.27%) were caught in small quantities in all the months of the year. *Hippolysmata* and *Solenocera indica* together formed 0.68%. The rest of the fishes formed 1.41% of the total catch. *Trypauchen vagina, Palaemon stylifera* and Squilla species occurred in small quantities in monsoon months only.

The Dol net catch is categorised into the following grades based on the consumer preference, of class I fish 8.32% consisting of penaeid prawn, *Stromateus* spp. and *Cybium;* class II fish 51.23% consisting of *P. tunuipes, H. nehereus, Hippolysmata, Solenocera, Coilia* etc. Class III fish 2.73% consisting of Sciaenids, *Thrissocles* etc. and class IV fish 37.68% consisting of *A. indicus* and *Trichiurus* etc. The non-edible fish *Trypauchen vagina* comprised 0.04%. The list of 33 species caught in Dol net catch and their annual percentages are given in the Table 3.

REMARKS

The increase or decrease in the monthly catch during the year has been mainly due to fluctuation of *H. nehereus* and *A. indicus.* These together with other prawns contributed to 80.44% of the total Dol net catch. The inverse relationship observed in the landings of *H. nehereus* and *A. indicus* is an interesting feature and detailed studies are necessary to determine the factors causing the same.

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STUDIES ON THE INTRASPECIFIC VARIATIONS IN *BRACHYTHEMIS CONTAMINATA* (FABRICIUS) (ODONATA: LIBELLULIDAE)[1]

M. Prasad and S. K. Ghosh[2]

(*With thirteen text-figures*)

Introduction

Brachythemis contaminata (Fabricius) is widely and most commonly available at temporary and permanent waterbodies. Variations within the species of Odonata have been briefly studied and reported by Asahina (1952-53); Singh and Baijal (1954); Baijal and Agarwal (1955); Singh and Prasad (1976, 1977); Prasad and Singh (1976); Prasad (1976a, 1976b); Raychaudhuri *et al.* (1969); Varshney and Guha (1972). A detailed study on the intraspecific variations in *Trithemis festiva* (Rambur) has been made by Prasad and Kumar (1981). Sahni (1970) while studying the Odonata fauna of Kumaon Hills has discussed in brief the intraspecific variations in *Brachythemis contaminata.* The present paper provides a detailed biometric analysis on the intraspecific variations alongwith a brief note on the field ecology, on the basis of material collected from different localities from India. All the measurements are in mm.

B. contaminata is distributed throughout the plains of India, Sri Lanka, Burma, China, Formosa, Philippines, Java and Sumatra (Fraser 1936); Lieftinck (1971); Kiauta (1975) and Kumar and Prasad (in press).

Observations

Male: Head small in size, Labium pale yellow to brownish yellow; Labrum dark yellow; face and vesicle pale greenish yellow; frons yellow, sometimes reddish yellow; eyes brown above; pale yellow laterally and beneath; occiput reddish brown. Prothorax brownish yellow; anterior and posterior border of middle lobe transverse by a dark brown stripe. Thorax yellowish brown dorsally marked with reddish brown humeral stripes; mid dorsal carina black. Legs pale yellow; femora dark brown on extensor surface; tibio tarsus yellowish brown; spines black. Wings short; rounded at apices; hyaline; reticulation closed; veins reddish in colour; a broad bright orange fascia extending from base to within 2 to 3 cells of pterostigma present in fore and hindwings. Variations in the marking of orange fascia in both fore and hindwings, only due to age of specimens (Figs. 1-3 and 6). Pterostigma rust red some times yellow in colour; membrane blackish brown; sector of arc fused at long origin. Arc situated in between 1st and 2nd antenodal nervures but more nearer to 1st antenodal nervures; discoidal cell in forewing narrow; costal side about half of the basal side or distal side; transversed only once; discoidal cell of hindwing with base at arc, entire; only one cubital nervure in both fore and hindwings. Cuii arising from the posterior angle of discoidal cell in hind wings;

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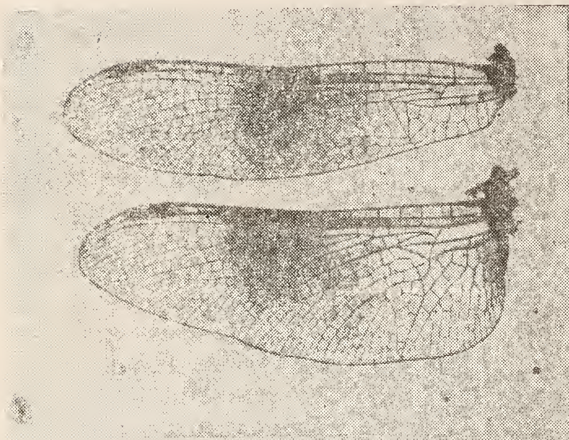

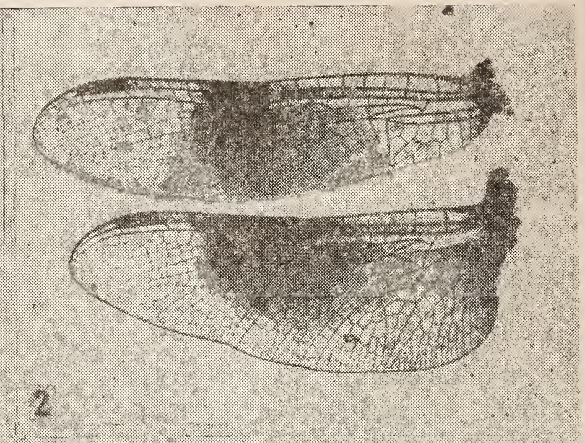

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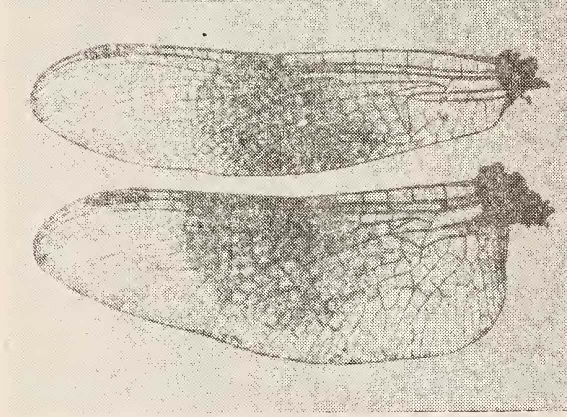

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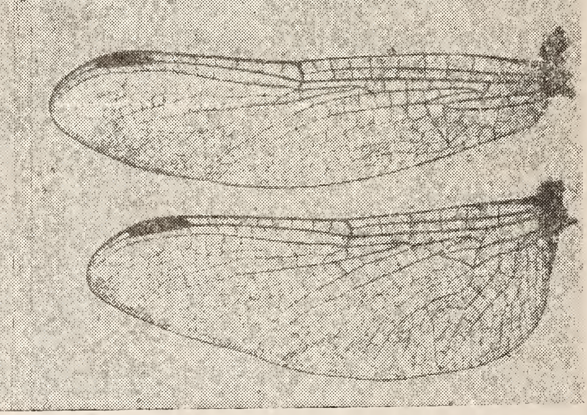

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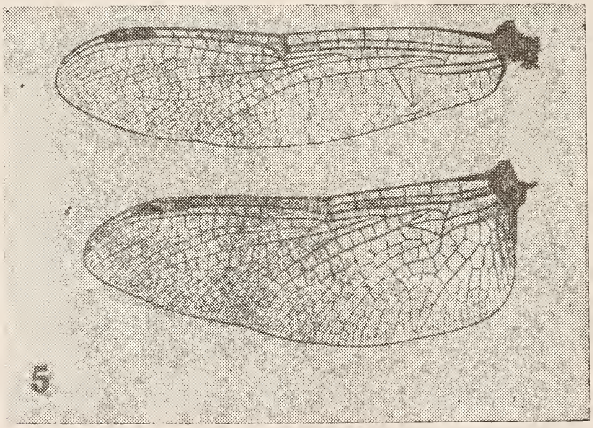

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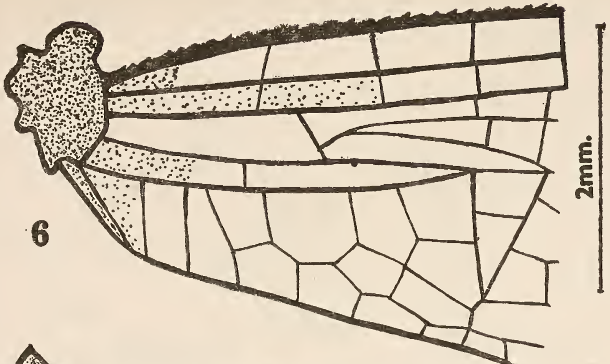
Figs. 1-3. Fore and hindwings of *Brachythemis contaminata* (Fabricius) (Male) showing variations in the marking of orange fascia.

Figs. 4&5. *Brachythemis contaminata* (Fabricius) (Female) showing variations in the number of nodal index.



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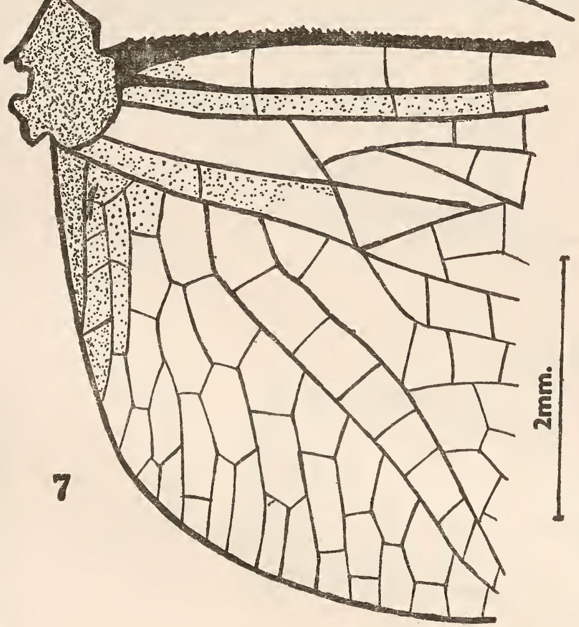

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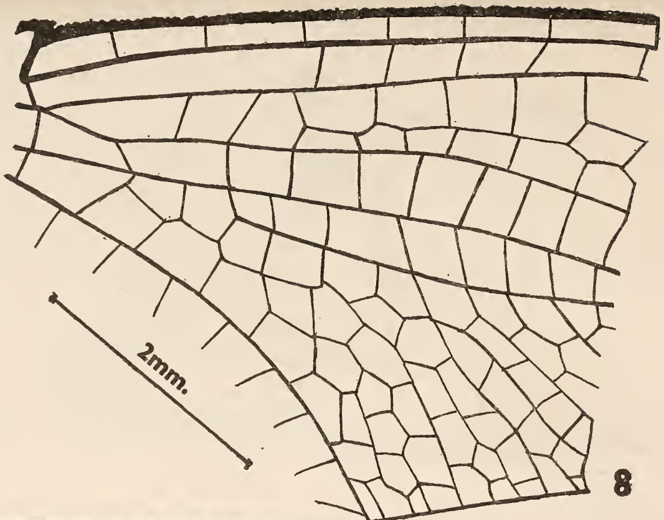

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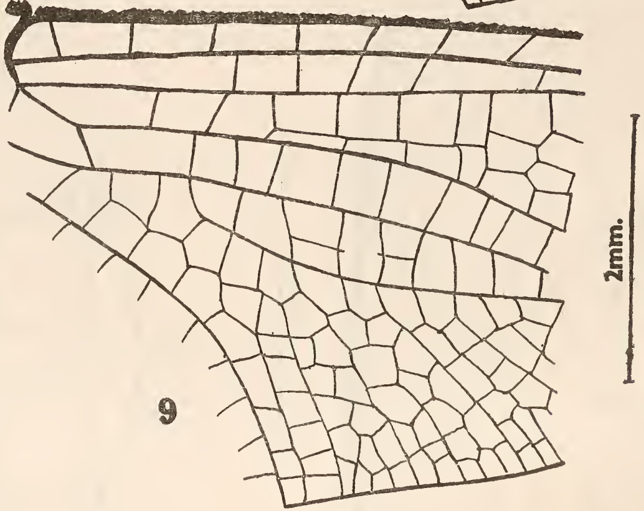

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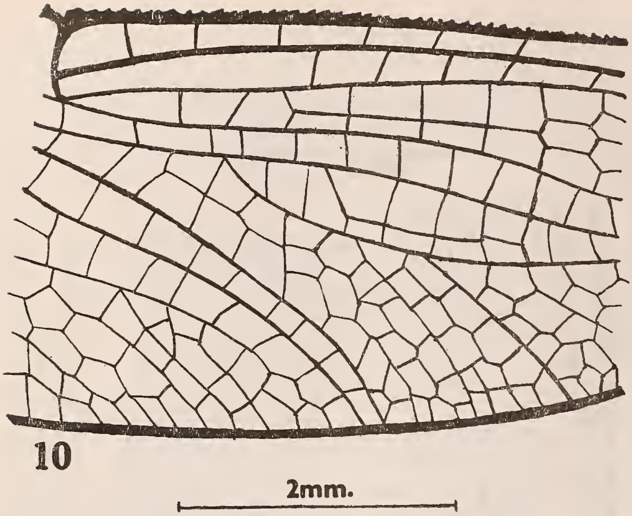
Figs. 6&7. Yellow marking at the base of both fore and hindwings of *B. contaminata*: 6. basal sides of forewing of male; 7. basal sides of hindwing of female.

Figs. 8-10. Showing rows of one to two alls in between IRiii & RSPL in both fore and hindwings of *B. contaminata.* (Fig. 10 on p. 344)



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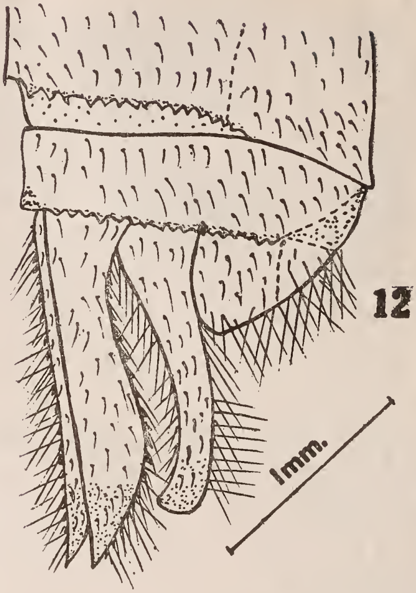

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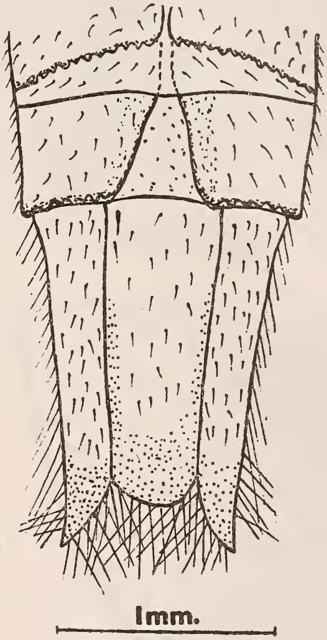

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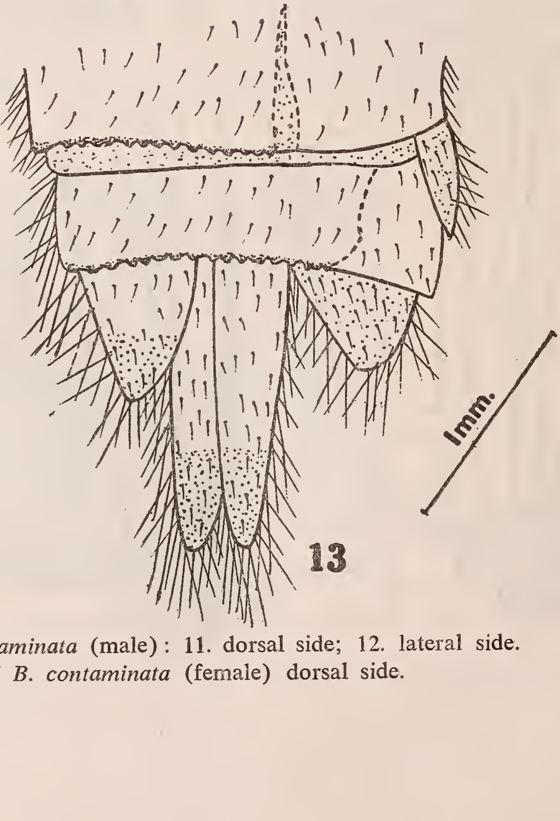

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Figs. 11&12. Anal appendages of *B. contaminata* (male): 11. dorsal side; 12. lateral side.
Fig. 13. Anal appendages of *B. contaminata* (female) dorsal side.

discoidal field beginning with 3 rows of cells; subtrigone in forewing three celled; one or two rows of cells in between IRiii & RSPL (Figure 8, 9 and 10), anal loop dilated at distal end and angulated. Nodal index as in Table 4. Abdomen reddish yellow marked with brown strips dorsally and sub-dorsally; segments 7th to 9th black on mid dorsum; tenerals or sub-adult specimens, similar to the female. Anal appendages brownish yellow, apices black (figs. 11 & 12); a black spot also present at the base of inferior anal appendages.

Genitalia: Lamina anterior small, arched and hood shaped; Ligula small and triangular in out line, Hamuli posterior small with obtusely rounded base, Hook also small directed backwards and inwards with rounded apex; Genital lobe long, highly curved with obtuse apex; prophallus divided into stem body and glans; stem long and cylindrical; body broad and divided into triangular proximal lobe and distal rounded lobe; glans of prophallus rounded and membranous, Vesicula spermalis flask shaped with a shallow notch at the base.

Female: Similar to male but differs in the following: Head-Labium light pale yellow to brownish yellow; Labrum yellowish in colour, Face, frons and vescicle pale yellow; eyes pale brown above. Thorax greenish yellow; a narrow brown marking parallel to mid-dorsal carina; a dark brown stripe present near humeral suture; narrow blackish stripe present on centres of mesepimeron and metapimeron; mid dorsal carina and lateral sutures black.

Wings: (figs. 4 & 5) hyaline; Hindwings very palely tinted with yellow at base as shown in fig. 7. In few specimens base of hindwings not tinted with yellow; bright orange fascia absent; pterostigma bright yellow; nodal index as shown in table 4. Abdomen yellowish brown with a narrow black strip on mid dorsal carina extending from 2nd segment to 9th segment; a broad brownish spot present on segments 8th, 9th and 10th; a subdorsal interrupted dark brown stripe present on segment 2nd to 6th; all sutures and ventral border black. Anal appendages yellowish brown and apices black, long, conical, acuminate at the apex (fig. 13) Vulvar scales two, short, triangular plate like and overlapping ninth segment.

TABLE 1

SHOWING THE FREQUENCY OF SPECIMENS OF *Brachythemis contaminata* (FABRICIUS) FROM DIFFERENT LOCALITIES

Sl. No.	Locality	District	Male	Female
1.	Changsari	Kamrup (Assam)	5	3
2.	Shaikhoa (Doom dooma)	Soekerating (Assam)	2	–
3.	Kanker (Gobindapur)	Bastar (M.P.)	1	1
4.	Jodhpur	Jodhpur (Rajasthan)	3	3
5.	Nischinda (Bally)	Howrah (W. Bengal)	1	3
6.	Raghunathpur	Nadia (W. Bengal)	1	–
7.	Amarawati	24-Parganas (W. Bengal)	3	2
8.	Bakkhali	„	4	3
9.	Fraserganj	„	9	2
10.	Kakdwip	„	6	–
11.	Trilokchandpur	„	6	1
12.	Sonadanga	„	4	–

Field ecology:

Adults of both sexes flew in large number around the banks of temporary as well as permanent ponds and marshy streams from April to October. Oviposition occurs between June to October. Larvae are sluggish in habit and commonly found in shallow waters of the

TABLE 2

BODY MEASUREMENTS OF *Brachythemis contaminata* (FABRICIUS) (MALE)

Sl. No.	Abdomen with anal appendages	Fore-wing	Hind-wing	Length in between base to node		Length in between node to pterostigma		Maximum width of Hindwing	Pterostigma
				Forewing	Hindwing	Forewing	Hindwing		
1.	18.00	23.00	22.00	11.00	10.50	7.50	8.00	8.50	3.00
2.	18.50	22.00	21.50	11.00	10.50	7.00	7.50	8.00	3.00
3.	18.50	23.50	22.50	11.20	10.00	7.50	8.00	8.50	3.00
4.	18.50	24.00	23.50	11.50	10.30	7.50	8.00	8.00	3.00
5.	19.00	22.50	21.50	11.00	9.50	7.00	8.00	8.50	3.00
6.	19.00	23.00	22.50	11.00	10.00	7.50	8.00	8.00	3.00
7.	19.00	23.00	22.50	11.00	10.50	7.00	7.50	8.00	3.00
8.	19.00	23.50	22.50	11.50	9.40	7.00	7.50	8.40	3.00
9.	19.00	23.50	23.00	11.00	10.00	7.50	8.00	8.00	3.00
10.	19.00	23.50	23.00	11.00	10.00	7.50	8.00	8.40	3.00
11.	19.00	24.00	22.50	11.80	9.80	7.00	7.00	8.40	3.00
12.	19.00	24.00	23.00	11.50	10.00	8.00	8.00	8.50	3.00
13.	19.00	24.00	23.00	11.00	9.50	7.50	7.50	8.50	3.00
14.	19.50	23.50	23.00	11.00	10.00	7.50	7.50	8.00	3.00
15.	19.50	24.00	23.00	11.00	10.00	7.00	8.00	8.20	3.00
16.	19.50	24.00	22.50	11.50	9.50	7.00	7.50	9.00	3.00
17.	20.00	23.00	22.40	11.00	10.50	7.50	8.00	8.00	3.00
18.	20.50	24.00	23.00	11.50	9.80	7.50	7.50	8.50	3.00
19.	21.00	25.50	24.50	12.00	10.50	7.00	7.50	8.50	3.00
20.	21.00	25.00	24.00	12.00	11.00	8.50	9.00	9.00	3.00
21.	21.50	25.00	24.50	12.50	11.50	8.00	9.00	9.50	3.00

TABLE 3

BODY MEASUREMENTS OF *Brachythemis contaminata* (FABRICIUS) (FEMALE)

Sl. No.	Abdomen with anal appendages	Fore-wing	Hind-wing	Length in between base to node		Length in between node to Pterostigma		Maximum width of Hindwing	Pterostigma
				Forewing	Hindwing	Forewing	Hindwing		
1.	19.00	24.00	24.00	12.50	10.50	7.50	7.80	8.50	3.00
2.	19.00	25.00	24.00	12.80	10.50	7.50	8.00	8.50	3.00
3.	19.00	25.00	24.50	13.00	10.50	8.50	8.80	8.00	3.00
4.	19.00	25.00	23.00	12.00	10.00	8.00	8.00	9.00	3.00
5.	19.50	25.50	24.00	13.00	11.00	7.80	8.50	8.50	3.00
6.	19.50	26.00	25.00	13.80	11.00	8.00	8.50	9.00	3.00
7.	20.00	23.00	22.50	12.00	10.00	7.50	8.00	8.00	3.00
8.	20.00	25.00	24.00	12.50	11.00	8.50	8.50	9.00	3.00
9.	20.50	25.50	25.00	12.50	11.00	8.00	8.50	8.50	3.00
10.	21.00	25.00	24.00	12.00	10.50	8.50	9.00	9.00	3.00

TABLE 4

SHOWING VARIATIONS IN NODAL INDEX WITHIN THE MALE AND FEMALE SPECIMENS OF *Brachythemis contaminata* (FABRICIUS)

Male		Female	
$5-7\frac{1}{2} \mid 7\frac{1}{2}-6$ —+— $6-5 \mid 5-7$			
$5-7\frac{1}{2} \mid 7\frac{1}{2}-7$, —+— $7-5 \mid 5-8$	$6-7\frac{1}{2} \mid 7\frac{1}{2}-8$, —+— $7-5 \mid 6-7$	$6-7\frac{1}{2} \mid 8\frac{1}{2}-7$, —+— $6-5 \mid 5-8$	$6-7\frac{1}{2} \mid 7\frac{1}{2}-6$ —+— $7-5 \mid 5-7$
$6-8\frac{1}{2} \mid 7\frac{1}{2}-6$, —+— $6-5 \mid 6-5$	$6-8\frac{1}{2} \mid 8\frac{1}{2}-8$, —+— $7-5 \mid 5-8$	$7-7\frac{1}{2} \mid 7\frac{1}{2}-7$, —+— $6-5 \mid 5-6$	$7-7\frac{1}{2} \mid 7\frac{1}{2}-6$, —+— $7-5 \mid 5-7$
$6-8\frac{1}{2} \mid 8\frac{1}{2}-7$, —+— $7-5 \mid 6-7$	$7-7\frac{1}{2} \mid 7\frac{1}{2}-8$ —+— $6-5 \mid 5-6$	$7-8\frac{1}{2} \mid 8\frac{1}{2}-6$ —+— $7-6 \mid 5-8$	
$7-7\frac{1}{2} \mid 7\frac{1}{2}-7$, —+— $7-5 \mid 5-8$	$7-7\frac{1}{2} \mid 7\frac{1}{2}-7$ —+— $7-5 \mid 5-7$		
$7-7\frac{1}{2} \mid 7\frac{1}{2}-7$, —+— $8-5 \mid 5-8$	$8-7\frac{1}{2} \mid 7\frac{1}{2}-7$ —+— $7-5 \mid 5-7$		

TABLE 5

SHOWING VARIATIONS IN BODY MARKING IN MALE AND FEMALE OF *Brachythemis contaminata* (FABRICIUS) AND COMPARED WITH THE PUBLISHED DESCRIPTION OF THE SPECIES

Sl. No.	Different parts of body	Male	Female	Published description of the species
1.	Labium	Pale yellow to brownish yellow	Same as male	Pale ochreous
2.	Labrum	Dark yellow	Light pale yellow	Reddish ochreous
3.	Nodal index	$5-7\frac{1}{2} \mid 7\frac{1}{2}-6$ to —+— $6-5 \mid 5-7$ $7-7\frac{1}{2} \mid 7-7\frac{1}{2}$ and —+— $8-5 \mid 5-8$ $8-7\frac{1}{2} \mid 7\frac{1}{2}-7$ —+— $7-5 \mid 5-7$	$6-7\frac{1}{2} \mid 8\frac{1}{2}-7$ to —+— $6-5 \mid 5-8$ $7-8\frac{1}{2} \mid 8\frac{1}{2}-6$ —+— $7-6 \mid 5-8$	$6-7\frac{1}{2} \mid 7\frac{1}{2}-6$ —+— $5-6 \mid 6-5$
4.	Base of the Hindwings in female	—	Base of hindwing may be tinted with yellow or hyaline	Base of hindwings in female palely tinted with yellow
5.	Anal appendages	Brownish yellow apices black	Yellowish brown apices black	Ferruginous in male, yellow in female with black apices.

ponds, amidst standing reeds. For emergence they climb on the reeds (Kumar 1973). A large number of exuviae can easily be collected during this period hanging on reeds about 4 inches to a foot above the water.

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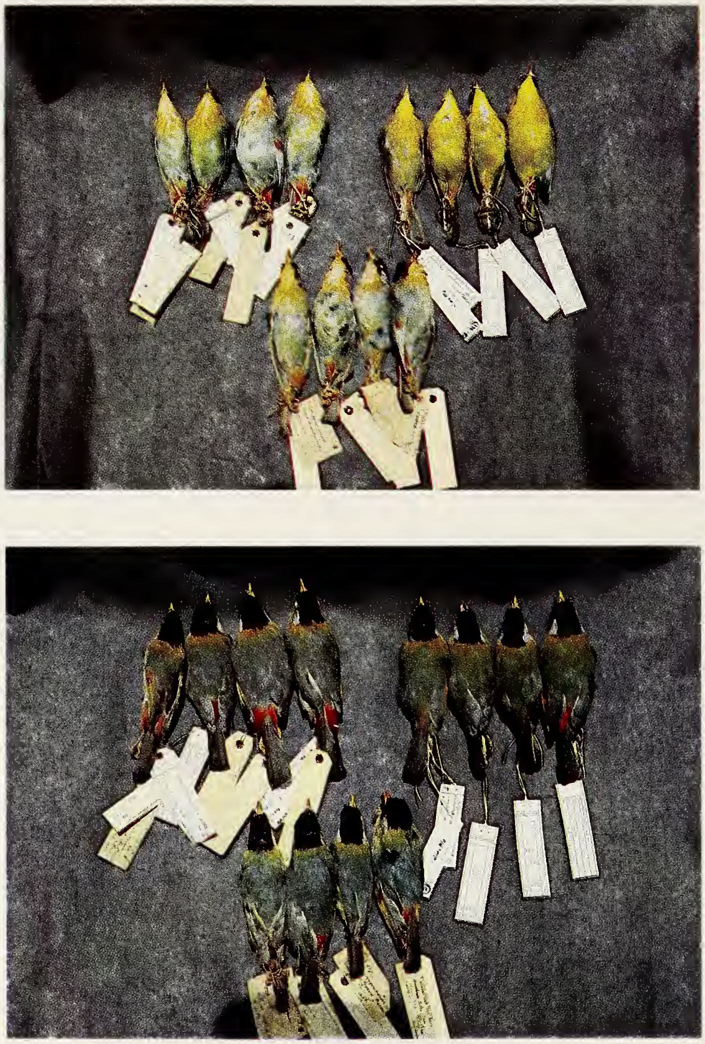

Colour changes in 1333 *Leiothrix a. argentauris*

1946 to 1968 1979 to 1981

1900 to 1917

(*Photos*: Asad Rafi Rehmani)

A CATALOGUE OF THE BIRDS IN THE COLLECTION OF BOMBAY NATURAL HISTORY SOCIETY — 28

MUSCICAPIDAE (Timaliinae) (*contd.*)

HUMAYUN ABDULALI

(*With a colour plate*)

[*Continued from Vol.* 80(1): 165]

667 specimens of 78 species and subspecies (including one undetermined and 9 extralimitals) are dealt with in this part. The last bird registered and handled is No. 26343. Mr. Eric D'Cunha, Research Assistant at BNHS has continued to help on a whole time basis, and the work now appears to proceed faster than ever before.

1333 **Leiothrix argentauris argentauris** (Hodgson) (Nepal) Himalayan Silver-eared Mesia 1:354

27: 10 ♂♂ 9 ♀♀ 8 o?

1 Kurseong, 2 Longview Tea Estate, 1 Darjeeling; 1 Samchi, West, 1 Mangdechu, Central, 1 nr. Aie River, 1 Bhutan; 2 Margherita, 1 Tezu, Lohit Valley, 1 Doyang, Sibsagar, Assam; 1 Rotung, 1 Mishing, Abor Country, Mishmi Hills, 2 Deban, 1 Miao, 1 Hornbill Camp, Arunachal Pradesh; 2 Kohima, Naga Hills; 2 Humgrum, 1 Gunjong, N. Cachar; 4 *N' Krang, Upper Burma.*

The birds from the Mishmi Hills and east and southwards were accepted as *vernayi* (Mayr & Greenway) No. 1334 in INDIAN HANDBOOK but in the second edition of SYNOPSIS (1982) these are synonymised with nominate *argentauris.* The three recent skins (Dec. 1981) and a fourth from Miao (1979) show an extraordinary amount of bright yellow on the chin and upper breast *contra* chestnut in four others from Lohit Valley (1946), Doyang (1952), Mangdechu (1967) and Samchi (1968). This is further reduced in two from Kohima, Naga Hills (1917) and exists only in pale traces in older skins (1900-1917). The underparts are also yellowish olive-green which lessens with the intensity of the chestnut, becoming a pale grey, darkest in 1912 (2 Abor Hills) and 1917 (2 Naga Hills) and almost disappearing in the older skins. The red on the wing and rump similarly changes colour and I would only have been able to separate the two races according to their distribution. The accompanying colour photograph will give an idea of the extraordinary changes which have taken place in a relatively short time.

Measurements on p. 362.

1334 **Leiothrix argentauris aureigularis** (Koelz) (Turza Mt., Garo Hills, Assam) Assam Silver-eared Mesia

Synonymised with 1333 in SYNOPSIS 1982.

1335 **Leiothrix lutea kumaiensis** Whistler (Dehra Dun, U.P.) Redbilled Leiothrix 1:328 (part)

7: 4 ♂♂ 3 ♀♀

2 Koti, 2 Jabli, Bhagat State, 2 Simla, 1 Simla Hills.

None have a gold wash on the head, while all four with red on the primaries (less than in *calipyga*) are males, including one juvenile with both wings and tail in moult. There is no red on the primaries of the three females as is found in *calipyga* and on the upperparts both sexes are greyer than that form.

Measurements on p. 362.

1336/7 **Leiothrix lutea calipyga** (Hodgson) (Nepal) Eastern Redbilled Leiothrix 1:328

10: 4 ♂♂ (1?) 5 ♀♀ 1 o?

1 Dentam, West, 3 Sikkim; 1 Chimakothi, West, 1 Bhumtang, 1 Shamgong, Central, 1 Gomchu, East Bhutan; 1 Kalaktang, Arunachal Pradesh; 1 Shillong, Khasia Hills.

All have a slight golden wash on the head, while red on the wings occurs in 5 specimens (1 ♂ 3 ♀♀ 1 o?). The first character is clearer in fresh specimens, but all show the drastic change in the yellow of the throat and breast referred to under 1333.

Measurements on p. 362.

1338 **Myzornis pyrrhoura** Blyth (Nepal) Firetailed Myzornis 1:345

7: 4 ♂♂ (1 o?) 3 ♀♀

3 Gedu, West, 2 Rongtong, 2 Wamrong, East Bhutan.

In the original description, reference was made to the black-centered scale-like green feathers of the head. This is correctly repeated in both editions of the Fauna, but INDIAN HANDBOOK (7 p. 70) refers to the crown being scalloped with black, in error for green. In the specimens available the males differ from the females in having a reddish wash on the breast and the undertail coverts more chestnut than the yellow in the females. The upperparts of the females are also greener than in the males where they are slightly washed with rufous.

Measurements on p. 362.

1339 **Cutia nipalensis nipalensis** Hodgson (Nepal) Nepal Cutia 1:329

12: 8 ♂♂ 4 ♀♀

1 Bagora, 2 Darjeeling, Bengal; 1 Singhik, N. Sikkim; 1 Shamgong, 2 Batase, Central, 1 Gomchu, 3 Wamrong, East Bhutan; 1 Abor Country, Mishmi Hills, Assam.

Measurements on p. 362.

1340 **Pteruthius rufiventer** Blyth (Darjeeling) Rufousbellied Shrike-Babbler 1:337

2 ♂♂

1 Shamgong, 1 Wamrong, East Bhutan.

The ♂ from Shamgong (No. 25014) marked as with enlarged testes (5 April 1967) shows traces of pale yellow patches on the sides of the breast which are joined by a thin yellow line across the breast.

Measurements on p. 362.

1341 **Pteruthius flaviscapis validirostris** Koelz (Kohima, Naga Hills, Assam) Redwinged Shrike-Babbler 1:331

38: 16 ♂♂ (1 juv.) 20 ♀♀ 2 o?

1 Baragali, Murree Hills; 1 Dalhousie, 1 Dharamsala, Kangra; 2 Mahasu, 2 Koti State, 1 Summer Hills, 9 Simla; 1 Dhanaulti, 1 Mogra, Mussoorie, 1 Almora, Kumaon; 2 Kurseong, 1 Longview Tea Estate, Darjeeling; 1 Martam, Rongni Valley, 1 Sikkim; 3 Tama, 2 Shamgong, Central, 3 Deothang, 1 Narphong, East Bhutan; 1 Tezu, Lohit Valley, U. Assam; 1 Naga Hills, 1 Cachar Hills; 1 *Chindwin, Burma.*

The fresher skins show a deeper chestnut on the wings. The juvenile male (No. 16148) has a grey head in which the feathers are broken and with pale central streaks.

Measurements on p. 362.

EL **Pteruthius flaviscapis aeralatus** Blyth (Mountainous interior of Tenasserim province, Lower Burma) Tickell's Shrike-Babbler 1:333

3: 1♂ 2 ♀♀ (1 juv.)

2 *N' Krang, U. Burma,* 1 *Loisong, N. Shan States, Burma.*

The male can be distinguished from *validirostris* (1341) by the outer half of the inner secondaries being golden yellow and the rest chestnut, while in the adult females there is only a small patch of chestnut on the innermost secondary. In the juvenile the head is concolorous with the back and feathers of the head are broken, with pale shaft streaks more prominent than in the specimen referred to under 1341.

Measurements on p. 362.

1342 **Pteruthius xanthochlorus occidentalis** Harington (Dehra Dun) Western Green Shrike-Babbler 1:336

5: 2 ♂♂ 1 ♀ 2 o?

1 Kufri, 1 Koti State, 3 Simla, N. W. Himalayas.

Measurements on p. 363.

1343 **Pteruthius xanthochlorus xanthochlorus** Gray (Nepal) Eastern Green Shrike-Babbler 1:335

3: 2♂♂ 1 ♀

1 Chapcha, 1 Chimakoti, West, 1 Wamrong, East Bhutan.

Measurements on p. 363.

1344 **Pteruthius xanthochlorus hybridus** Harington (Mt. Victoria, Chin Hills) Chin Hills Green Shrike-Babbler

nil.

1345 **Pteruthius melanotis melanotis** Hodgson (Nepal) Chestnut-throated Shrike-Babbler 1:333

6: 4 ♂♂ 2 ♀♀

2 Singhik 3500′ North, 1 Martam, Rongni Valley 2000′, Sikkim; 1 Wamrong, 8000′; 1 Narphong 5600′, 1 Gomchu 7500′ East Bhutan.

The two males from Singhik, North Sikkim show the brightest yellow on the foreheads which is preceded by a thin black line. These differences may only be a phase in plumage.

Measurements on p. 363.

1346 **Pteruthius aenobarbus aenobarbulus** Koelz (Nokrek, Garo Hills) Chestnutfronted Shrike-Babbler 1:335

nil.

1347 **Gampsorhynchus rufulus rufulus** Blyth (Darjeeling) Whiteheaded Shrike-Babbler 1:231

20: 8 ♂♂ (3 imm) 7 ♀♀ (2 imm) 5 o? (2 imm)

2 Longview T. E., Darjeeling; 1 Dening, 1 Teżu, Lohit Valley, U. Assam; 2 Margherita, Assam; 4 Miao, Tirap div. Arunachal Pradesh; 2 Roopachena, 1 Bago Bahar, Cachar; 2 *Tawmaw,* 1 *Maymyo,* 2 *Mansun,* 2 *Loikaw, N. Shan States, Burma.*

The immature birds have brown heads. The four most recently collected at Miao, A.P. (1979) are olivegreen on the upper parts *contra* rufous in all the others (1946 and earlier).

Measurements on p. 363.

1348 **Actinodura egertoni egertoni** Gould (Nepal) Himalayan Barwing 1:303

8: 3 ♂♂ 3 ♀♀ 2 o?

1 Tongloo, Darjeeling, 1 Sikkim, 2 Gedu, 3 Honka, west, 1 Shamgong, Central Bhutan.

In series the backs are a paler and more rufous brown than in *lewisi.*

Measurements on p. 363.

1349 **Actinodura egertoni lewisi** Ripley (Dreyi, Mishmi Hills) Mishmi Barwing

7: 2 ♂♂ 4 ♀♀ 1 o?

5 Dreyi, Lohit Valley, N. E. Assam, 1 Rotung, Abor Country, Mishmi Hills, 1 Kohima, Nagaland.

The topotypes collected in 1947 are marked *egertoni* by Sálim Ali and later (1948) separated as *lewisi.* The backs are slightly darker than in the nominate form, and the head shows more rufous, but the species shows considerable individual variation in colour, and the subspecific characters in current literature are not very consistent. One old skin from Kohima borrowed from the Zoological Survey of India is marked *khasiana,* while the specimen listed above agrees more closely with topotypes of *lewisi.* An examination of more material from that area, collected at about the same time, may perhaps remove the present necessity of grouping the subspecies to some extent on geographical grounds.

Measurements on p. 363.

1349a **Actinodura egertoni** subsp ?
3:1♂2♀♀

3 from Miao, Tirap div., Arunachal Pradesh collected in 1979 should, distributionally, as in INDIAN HANDBOOK, be *lewisi*, but they have almost pure grey heads and an olive wash on the upperparts which renders then quite different.

Measurements on p. 363.

1350 **Actinodura egertoni khasiana** Godwin-Austen (Khasia Hills) Assam Barwing 1:304
3: 1 ♂ 2 ♀♀
1 Shillong, 1 Cherrapunji, Khasia Hills, 1 Hungrum, N. Cachar.

These can be immediately separated by their ashy brown heads, as in the original description. Two more from Kohima (ZSI No. 29581, 1936, Ptutse-Ru Tekhubama, *c.* 22 km SE of Kohima) and N. Cachar borrowed from the Zoological Survey of India, do not agree, while a fresher (Jan. 1952) specimen from Kohima has been placed with *lewisi* (*q.v.*).

Measurements on p. 363.

1351 **Actinodura egertoni ripponi** Ogilvie-Grant (Mt. Victoria, Chin Hills, 6000-7000′) Mizo Barwing 1:305
5 o?: 3 *Mt. Victoria, 2 N. Shan States, Burma.*

These birds appear larger than the foregoing specimens than is suggested by the measurements, with the feathers on the head paler and apparently broader.

Measurements on p. 364.

1352/3 **Actinodura nipalensis nipalensis** (Hodgson) (Nepal restricted to slopes of Khatmandu Valley, Central Nepal) Nepal Hoary Barwing 1:307
9: 4 ♂♂ 4 ♀♀ 1 o?
2 Tongloo, Darjeeling, 1 Lachung, N. Sikkim; 1 Gedu, West, 5 Wamrong East Bhutan.

In 1950, Ripley described *A. n. vinctura* from East Nepal, but later (1980 *JB* 76 pp. 21-23) said they were not separable on the characters mentioned. Among the present specimens the seven from Darjeeling (5 including 3 borrowed from Zoological Survey of India) 1 N. Sikkim & 1 Gedu, West Bhutan can be separated from 5 from Wamrong, E. Bhutan, by the streaks on the head being paler and more prominent than in the latter in which the head is duskier. In view of the drastic colour changes incurred by birds from this area and the fact that the western birds (except one 1968 from West Bhutan) are old specimens, I am leaving them all under nominate *nipalensis.*

Incidentally, the 2nd Edition of SYNOPSIS (1982) erroneously accepts *vinctura*, overlooking the correction made in 1980 (loc. cit.), by the same author !

Measurements on p. 364.

1354 **Actinodura nipalensis daflaensis** Godwin-Austen (Dafla Hills, NE. Bengal) NEFA Barwing 1:309
2 ♀♀ Bomdila, Arunachal Pradesh.

Measurements on p. 364.

1355 **Actinodura nipalensis waldeni** Godwin-Austen (Japoo Peak, Naga Hills) Manipur Barwing 1:308
1 ♂ topotype Mt. Japoo, Naga Hills.

Measurements on p. 364.

1356 **Actinodura nipalensis poliotis** (Rippon) (Mt. Victoria, 7000-8000 ft.) Chin Hills Barwing 1:309
nil.

1357 **Minla ignotincta ignotincta** Hodgson (Central and Northern regions of the Hills, Nepal) Redtailed Minla 1:355
24: 15 ♂♂ (2 by pl.) 9 ♀♀ (1 by pl.)
4 Kurseong, Darjeeling; 2 Rinchinpong, West, 1 Singhik, 1 Martam, Rongni Valley, 1 Tung, Sikkim;

1 Gedu, 1 Phuntsholing, West, 1 Batase, 2 Shamgong, Central, 1 Rongtong, 4 Wamrong, East, 2 Bhutan; 1 Saroq Hills, Upper Assam; 1 Kohima, Naga Hills, 1 Kongpokpi, Manipur.

7 ♂♂ collected in 1944 or earlier, have yellow edges to the tail while in 8 from 1952 onwards, the tails are red. The edging to the wing has also faded in the same manner and time.

Measurements on p. 364.

1358 **Minla strigula simlaensis** Meinertzhagen (Simla) Western Barthroated Siva 1:313 (part)

16: 7 ♂♂ 7 ♀♀ 2 o?

2 Koti State, 1 Kufri, Patiala State, 9 Simla, 1 Dhanaulti, east of Mussooree, 2 Dakuri, Almora, Uttar Pradesh, 1 Nepal Valley.

The last from Nepal is very badly damaged and may be of the next form.

Measurements on p. 364.

1359 **Minla strigula strigula** (Hodgson) (Nepal) Eastern Barthroated Siva 1:313 (part)

15: 9 ♂♂ 4 ♀♀ 2 o?

2 Tongloo, Darjeeling; 3 Rinchingpong; West 1 Lachung-Chungthong, N. Sikkim, 1 Chimakothi, West, 1 Shamgong, 1 Tongsa, Central 2 Narphong, 4 Wamrong, East Bhutan.

In series these are more yellow below than *simlaensis* and a richer rufous on the forehead. The rufous on the tail is not less than half the length of the tail as required in the key in IND. HANDBOOK, but noticeably less than in the next two races. The two from Tongloo, Darjeeling (♂ No. 1501) and Lachung-Chungthong, N. Sikkim (o? No. 21660) have their foreheads yellower than in the others, with the former having a yellower bill.

Measurements on p. 364.

1360 **Minla strigula yunnanensis** (Rothschild) (Lichiang Range, NW. Yunnan) NEFA Barthroated Siva 1:313-14 (part)

2 o?

1 *Loi Lum, N. Shan States,* 1 *Burma?* (Both collected by H. Wood).

Their forehead is duller than in nominate *strigula* and they also measure slightly larger. The extent of rufous on the tail is more pronounced.

Measurements on p. 364.

1361 **Minla strigula cinereigenae** (Ripley) (Mt. Japoo, Western Naga Hills, Assam) Assam Barthroated Siva 1:313 (part)

1 ♀ Mt. Japvo, Naga Hills, Assam.

The single specimen from the type locality lacks the rufous forehead of nominate *strigula* and the rufous in the tail is as prominent as in *yunnanensis* above. Peters' CHECKLIST 1964 (10 p. 396) refers to it as doubtfully distinct from *yunnanensis.*

Measurements on p. 364.

1362 **Minla cyanouroptera cyanouroptera** (Hodgson) (Nepal) Bluewinged Siva 1:314

31: 9 ♂♂ 15 ♀♀ 7 o?

1 W. Kumaon, 1 Mornaula, 2 Kumaon, Nainital dist., U.P.; 1 Godaveri, Nepal; 2 Kurseong, 1 Longview, Darjeeling; 1 Rinchinpong, West, 2 Singhik, 2 Rongpo, 1 Singtam, Teesta Valley, 1 Sikkim; 1 Shamgong, Central, 3 Deothang, 1 Rongtong, East Bhutan; 1 Dibrugarh, 1 Dening, Lohit Valley, 4 Margherita, Assam; 1 Namorah, Arunachal Pradesh; 1 Baraha Pani, 1 Shillong; 2 Kohima, Naga Hills.

There is some variation in the colour of the head and of the underparts and the intensity of brown above, but the material available does not permit any definite divisions. McClelland's *lepida* from Assam was described for its light bluish-grey underparts and the specimens from Sikkim, Bhutan, Dening, Lohit Valley and Namora, Arunachal Pradesh do have *greyish* underparts and perhaps slightly larger bills. The description of Deignan's *aglae* (Mt. Victoria, Western Burma, South east Assam) is not available, but except for faint white marking to the inner primaries the specimens from the Naga Hills do not appear separable. Ludlow & Kinnear, *Ibis* 1937 p. 41 refer to the female in fresh plumage being flushed with yellow on the underparts, but this colour is not visible in any specimen nor mentioned in IND. HANDBOOK.

Measurements on p. 364/5.

EL. **Minla cyanouroptera wingatei** (Ogilvie-Grant) (W. Kumaing, Yunnan) 1:315

4 o?

1 *N' Krang*, 2 *Sima, Upper Burma;* 1 *Loisong, N. Shan States.*

These lack the white tips to the inner secondaries.

Measurements on p. 365.

1363 **Yuhina castaniceps rufigenis** (Hume) (Himalayas = Darjeeling) Sikkim Whitebrowed Yuhina 1:311 (part)

6: 3 ♂♂ 2 ♀♀ 1 o?

1 Martam, Rongni Valley, Sikkim; 2 Tama, 1 Mangdecha, C. Bhutan, 2 Beni Changs, 3500′, Saroq Hills, Upper Assam.

Measurements on p. 365.

1364 **Yuhina castaniceps plumbeiceps** (Godwin-Austen) Nr. Sadya and Brahmakhend, Eastern Assam) Mishmi Whitebrowed Yuhina 1:311

2: 1 ♂ 1 ♀

1 Embiong, 1 40th. m. from Miao, Deban Div. Arunachal Pradesh.

By distribution these should be *plumbeiceps,* but the rufous ear-coverts extend to about the same level in both in this and *rufigenis,* while both have a rufous patch at the posterior end of the supercilium. The head is perhaps greyer, but these are fresher, 1979, skins, *contra* 1967 and earlier. The two were synonymised by Oates in FAUNA 1:206 and this was confirmed by Baker (1:311). The revival of *plumbeiceps* in INDIAN HANDBOOK and in SYNOPSIS (1982) is not explained. Though ignored by later workers, it may however be worth keeping in mind that when Hume named this bird he was referring to the Himalayan form of *striatus* in which the underparts were said to be brownish by both Blyth and Tickell, and in which the latter said the central tail feathers and the quills were reddish clay brown.

With the evidence available I would include 1364 with 1363, the latter appearing in the June number of *Stray Feathers,* 1877, and the former in *Ann. Mag. Nat. Hist.* 20: 219 published in December the same year.

Measurements on p. 365.

1365 **Yuhina castaniceps castaniceps** (Moore) (Afghanistan, errore = Cachar) Chestnut-headed Yuhina 1:310

5: 1 ♂ 3 ♀♀ 1 o?

1 Shillong, 3 Cherrapunji, Cachar, 1 no data.

Measurements on p. 365.

EL. **Yuhina castaniceps striata** Blyth (Tenasserim) Striated Yuhina (Tickell's Staphidia in Fauna) 1:311

2: 1 ♀ 1 o?

1 Thandung, Karen Hills, 1 North Shan States.

The distribution of this form is said to extend as far north as the South Shan States (Peters, x. p. 422). The first is heavily streaked on the upperparts while the other may almost be included with *rufigenis.*

Measurements on p. 365.

1366 **Yuhina bakeri** Rothschild (Darjeeling) Whitenaped Yuhina 1:321

8: 2 ♂♂ 5 ♀♀ 1 o?

1 Chungthang, N. Sikkim; 1 Batase, Central Bhutan, 1 Joyhing Gorge, N. Lakhimpur, Upper Assam, 1 Rotung, Abor country, 1 Dibang Valley, Mishmi Hills, 2 Miao, Tirap Div., A. P., 1 Hungrum N. Cachar.

Four of these were listed under *Yuhina occi-*

pitalis presumably because this name was once used for *bakeri* but has been invalidated.

Measurements on p. 365.

1367 **Yuhina flavicollis albicollis** (Ticehurst & Whistler) (Dharmsala, 4000′ Kangra) Western Yellownaped Yuhina 1:322

18: 10 ♂♂ 7 ♀♀ 1 o?

2 Koti State, 1 Patiala State, 1 Kalka, 2 Pulbal, 7 Simla, 1 West, 1 Kumaon; 1 Rampur, Gharwal, 1 Dhanaulti, 1 Mussoorie U.P.

Measurements on p. 365.

1368/9 **Yuhina flavicollis flavicollis** Hodgson (Nepal, restricted to Central Nepal) Eastern Yellownaped Yuhina 1:322

22: 8 ♂♂ 12 ♀♀ 2 o?

1 Nepal, 4 Longview T.E., 2 Darjeeling, 1 Buxa Duars, Bengal; 2 Singtam, 1 Chungthang, 1 Singhik, 1 Sikkim; 1 Gedu, West, 1 Shamgong, 1 Batase, 1 Tama, Central, 2 Deothang, 1 Gomchu, 1 Narphong, 1 Wamrong, East, Bhutan.

Measurements on p. 365.

1370 **Yuhina flavicollis rouxi** (Oustalet) (Ly-Sien-Kiang or Black River, Yunnan) Assam Yellownaped Yuhina 1:323

7: 1 ♀ 6 o?

1 Kalaktang, Arunachal Pradesh, 1 Hungrum, N. Cachar; 1 *N. Shan States,* 3 *Loi-Wong, S. Shan States,* 1 *Mt. Victoria, Burma.*

The two from Arunachal Pradesh and N. Cachar appear intermediate between nominate *flavicollis* and *rouxi.*

Measurements on p. 366.

1371 **Yuhina gularis vivax** Koelz (above Luni, Tehri, United Provinces, 10000′) Western Stripethroated Yuhina

nil.

1372 **Yuhina gularis gularis** Hodgson (Nepal) Eastern Stripethroated Yuhina 1:317

11: 8 ♂♂ 3 o?

1 Kewzing, West, 1 Lachung, North, Sikkim, 1 Bhutan Duars, 1 Chapkha, West, 1 Shamgong, Central, 1 Rongtong, 1 Gomchu, 2 Wamrong, East, Bhutan; 1 Aka Hills, NE Assam; 1 *N. Shan States, Burma.*

Measurements on p. 366.

EL. **Yuhina diademata ampelina** Rippon (Waror Bum 30 miles, east of Bhamo, Kachin State, U. Burma) 1:318

1 o? *North Shan States, Burma.*

The specimen is marked *ampelina,* Rippon, but this race is accepted in Vaurie's *Palaearctic Fauna* (1959) and dropped in Peters' CHECKLIST (1964, x p. 424). Without any material for comparison it is not possible to express any opinion.

Measurements on p. 366.

1373 **Yuhina occipitalis occipitalis** Hodgson (Nepal) Slatyheaded or Rufousvented Yuhina 1:319

10: 8 ♂♂ 2 ♀♀

(a) 1 Kurseong, Darjeeling, Bengal; 2 Bolandeny, Sikkim; 1 nr. Dochu La, West Bhutan.

(b) 2 Gomchu, 2 Deothang, 1 Wamrong, East Bhutan; 1 Kalaktang, Arunachal Pradesh.

The first four (a) from nearer the type locality show more rufous on the lower belly and vent than the six more eastern birds (b). The examination of a larger series may perhaps warrant separation.

Measurements on p. 366.

1374 **Yuhina nigrimenta nigrimenta** Hodgson (Nepal) Blackchinned Yuhina 1:320

16: 6 ♂♂ 8 ♀♀ 2 o?

4 Ranibagh, 1 Kumaon, U.P.; 2 Dikchu, North, 1 Singatam Teesta Valley, Sikkim, 1 Buxa Duars, 1 Lodrai, 1 Mangdechu 2 Tama, Central Bhutan; 2 Saraq Country, Upper Assam; 1 Dening, Lohit Valley, NE Assam.

Measurements on p. 366.

1375 **Yuhina xantholeuca xantholeuca** (Hodgson) (Central region of Nepal) White-bellied Yuhina 1:325

24: 8 ♂♂ 12 ♀♀ 4 o?

1 Berrik, Sikkim; 1 Tama, 1 Lodrai, Central, 1 Bhutan; 6 Margherita, Lakhimpur; 2 Miao, 1 Tirap Div., Arunachal Pradesh; 2 Laithensew, Khasia Hills; 1 Kangpokpi, Manipur; 1 *N. Cachar,* 3 *Hai Bum, Chindwin Exp.;* 2 *Nyannggyo, Prome Dist.,* 1 *Thayetmyo Dist.,* 1 *Burma.*

The older skins have lost the olivegreen on the upper parts and show more yellow, while the fresh material after April 1967 shows more yellow on the vent and grey on the underparts. Several specimens show dark feather shafts on the head, presenting a streaked appearance which cannot be linked with place or season. This has not been referred to in the FAUNA or INDIAN HANDBOOK.

Measurements on p. 366.

1376 **Alcippe chrysotis chrysotis** (Blyth) Himalaya = Nepal) Himalayan Goldenbreasted Tit-Babbler 1:293

7: 4 ♂♂ 1 ♀ 2 o?

1 Tongloo, Darjeeling, 1 Gedu, West, 4 Shamgong, Central Bhutan; 1 Bomdila, Arunachal Pradesh.

♂ Sp. 19855 obtained by C. M. Inglis at Darjeeling on 6th July 1904 is not included in his *Birds of Jalpaiguri Dist.* (*JBNHS* 26: 988-999) and differs from the others in having no yellow on the underparts, the white feathers being tipped with pale brown, presumably the effect of fading. The wing, bill and tarsus are the smallest in the series but can no doubt be included in the range.

Measurements on p. 366.

1377 **Alcippe chrysotis albilineata** (Koelz) (Karong, Singtun, Manipur) Assam Goldenbreasted Tit-Babbler 1:293

nil.

1378 **Alcippe cinerea** (Blyth) (Darjeeling) Dusky Green or Yellowthroated Tit-Babbler 1:287

10: 5 ♂♂ 4 ♀♀ 1 o?

2 Gedu, West, 1 Shamgong, 1 Batase, Central Bhutan; 2 Benichangs, 2 Dreyi, Lohit Valley, Upper Assam; 1 Bomdila, 1 Kalaktang, Arunachal Prakesh.

The key in INDIAN HANDBOOK (7 p. 110) requires a yellow supercilium for the species and the name and description on p. 112 refer to a yellow throat and underparts. Except for a very slight trace of yellow on the lores and underparts in two from Arunachal Pradesh (1978), the others collected earlier show pure white and no yellow—another example of the rapid fading of colour in birds from the north-east.

Measurements on p. 366.

1379 **Alcippe castaneceps castaneceps** (Hodgson) (Chandragiri Pass, Central Nepal) Chestnut-headed Tit-Babbler 1:288-9

16: 4 ♂♂ 10 ♀♀ 2 o?

1 Sheopuri Ridge, Nepal Valley, 1 Kewzing Temi, West Sikkim; 1 Chimakothi, West, 4 Shamgong, Central, 3 Wamrong, 1 Gomchu, 1 Rongtong, East Bhutan; 1 Tezu, Lohit Valley, U. Assam; 2 Miao, Tirap Div., Arunachal Pradesh. 1 *Loi-Panghen, nr. Mehong River, Burma.*

Several races *brunneicauda* Khasi Hills, Sharpe, *garoensis,* Garo Hills, Koelz and *nagaensis,* Naga Hills, Koelz, have been described from eastern India, but though some variations are visible there is insufficient material to uphold any of them. IND. HANDBOOK (7 p. 113) refers to a rufous patch on the wing feathers but in the western birds this is closer to yellow or orange as stated in earlier literature. The two from Arunachal Pradesh have darker brown heads as well as wing feathers. The bird from the Mekong River, presumably in Burma, collected by H. N. Thomson in 1902 is in tatters and badly faded.

Measurements on p. 367.

1380 **Alcippe vinipectus kangrae** (Ticehurst & Whistler) Palumpur, 6000′, Kangra) Western Whitebrowed Tit-Babbler 1:290 (part)

7: 4 ♂♂ 3 ♀♀

6 Narkanda, Kumarsain, Simla, Himachal Pradesh, 1 Dakuri (Kumaon Hills), Nainital, U.P.

The chestnut on the head forms a very distinct cap.

Measurements on p. 367.

1381 **Alcippe vinipectus vinipectus** (Hodgson) (Nepal, except area occupied by *chumbiensis*) Nepal Whitebrowed Tit-Babbler 1:290 (part)

nil.

1382 **Alcippe vinipectus chumbiensis** (Kinnear) (Yatung, Chumbi Valley) Eastern Whitebrowed Tit-Babbler 1:290 (part)

19: 8 ♂♂ 8 ♀♀ 3 o?

1 Mangalbare, Nepal; 2 Sandakphaw, 1 Phalut. Darjeeling, 1 Kewzing-Temi, West, 5 Lachung, 1 Chungthan, North Sikkim; 4 Bhumthang, 2 Chimakothi, 1 Chapcha, 1 nr. Dochu La, West Bhutan.

The streaking on the throat is indistinct in some but it is not possible to place any with nominate *vinipectus*. The dark brown coronal stripes referred to in the key in INDIAN HANDBOOK (7 p. 114) also presumably include the dark streaks behind the eyes converging on the nape.

Measurements on p. 367.

1383 **Alcippe vinipectus austeni** (Ogilvie-Grant) (Manipur and the Naga Hills) Assam Whitebrowed Tit-Babbler 1:291

nil.

1384 **Alcippe cinereiceps ludlowi** (Kinnear) (Sakden, Eastern Bhutan) Himalayan Brownheaded Tit-Babbler

nil.

1385 **Alcippe cinereiceps manipurensis** (Ogilvie-Grant) (Owenkulno Peak, Manipur Hills) Manipur Brownheaded Tit-Babbler 1:292

nil.

1385a **Alcippe striaticollis** (Verreaux) (Muping) Streakthroated Tit-Babbler

nil.

1386 **Alcippe rufogularis rufogularis** (Mandelli) (Bhutan Duars) Himalayan Redthroated Tit-Babbler 1:286

nil.

1387 **Alcippe rufogularis collaris** Walden (Sadiya, Upper Assam) Assam Redthroated Tit-Babbler

13: 5 ♂♂ 8 ♀♀

1 Sadiya, 8 Margherita; 2 Firm Base, 1 Miao, Tirap Div., Arunachal Pradesh; 1 *Lok-Kawhka, Chindwin, Burma.*

The two races are separated in IND. HANDBOOK (7 p. 119) by *collaris* being darker on the crown and with the back rufescent brown and distributionally divided by the Dihang River in Arunachal Pradesh, north of the Brahmaputra. The three most recent skins (1979 & 1981) from Firm Base and Miao, Tirap Div., A.P., differ from the others (all 1946 and earlier) in being less rufous on the head and upperparts. However, without any topotypes of nominate *rufogularis* (or anything west of the Dihang) it is not possible to say if the material is of one or more races.

Measurements on p. 367.

1388 **Alcippe brunnea mandelli** (Godwin-Austen) (Naga Hills, Northeast Bengal) Rufousheaded Tit-Babbler 1:284

3 o?

Measurements on p. 367.

1389 **Alcippe poioicephala** subsp ? Quaker Babbler : Paler northern birds

38: 15 ♂♂ 17 ♀♀ 6 o?

1 Waghai, 1 Malegaon, 1 Songadh, Navsari, 1 Surat Dangs, 1 Pimpri, Surat, Gujarat; 1 Paryat, Jubbalpore, 2 Bori Forest, Hoshangabad, 1 Antagarh, 1 Darba, 1 Karnali, 2 Bailadila, 1 Chota Dongar, 1 Amraoti, Bastar, C. P.; 1 Pili, 1 Chikalda, Melghat, Berar, Maharashtra; 1 Kutri, Daspalla, 2 Badrama, Burma, Orissa; 3 Jeypur Agency, 1 near K. V. Nagar, Vizagapatnam District, 6 Sankrametta, 3 Anantgiri; 3 Yercaud, Salem District, 2 Shevaroy Hills, Tamil Nadu.

Alcippe poioicephala brucei currently accepted as a good subspecies has a curious history. Referring to some notes by Fairbank which separated birds from Mahableshwar from those from the Nilgiris [the type locality of *poioicephala* (Jerdon)] Hume, 1870, (*JASB* 39: 129) positively said that none of the characters mentioned i.e. size, depth of colour of upperparts and ferruginosity of the underparts were consistent and that the two were identical.

As Fairbank never published his report, the authorship was attributed to Hume though he had only denied its validity (Blanford's Fauna, 1, footnote on p. 158, where it was synonymised with the nominate race) but later accepted by Stuart Baker (Fauna 1, p. 278) who was really only quoting Harington as occurring at "Mahabaleshwar, Western ghats from Rajkot in Kathiawar to Belgaum, the Central Provinces; Pachmari and the Parasnath Hill, Lower Bengal".*

Thereafter, Whistler & Kinnear in the *Eastern Ghats Survey Report* (1932, *JBNHS* 35, p 745) named all the birds from the Shevaroy and Chitteri Hills north to the Vizagapatnam Hills and the Jeypur Agency as *brucei*. They said it could not be separated from those from the Western Ghats "where this species occurs from the Goa Frontier to West Khandesh and Rajkot in Kathiawar".

Later (1935, *JBNHS* 38, p. 80) when reporting on Sálim Ali's collection from Travancore and Cochin, Whistler said "*A. p. brucei* differs from this, the typical race, in being altogether paler. The crown and nape are a clearer colder grey, the rest of the upperparts are greyer and colder with less brown in them; the wings and tail are not so dark. The lower parts are also much paler, washed with greyer brown, as compared with rich fulvous. It is also slightly larger."

In *Birds of Mysore* (1942, *JBNHS* 43, p. 322) Whistler said the birds collected from this area were *brucei* including 2 from the Biligirirangan Hills, though he added that an earlier series from the same place were "intermediates between *poioicephala* and *brucei* being definitely more richly coloured than the Survey series."

In INDIAN HANDBOOK 1972 (7 p. 122) *brucei* is said to be paler and greyer than *poioicephala* and occurring in the hills of the Indian peninsula, except for the range of the nominate race which is shown to be restricted to the Ghats along the southwest but to intergrade with *brucei* in southwestern Maharashtra, Goa and the Biligirirangan Hills which statement is repeated in the second edition of SYNOPSIS (1982 p. 378). In the meantime however, Robert Grubh and Sálim Ali have identified 5 specimens recently collected in Goa as of the nominote form (1976, *JBNHS* 73, p. 48).

In the present study it was evident that birds from the Bombay area, Khandala and Goa showed much individual variation and some were indeed impossible to separate from nominate birds from the Nilgiris. There can be little doubt that the uncertainty and confusion was revived by comparison of the southwestern birds with the large series obtained in the Eastern Ghats assuming that the latter were *brucei* and failing to note that topotypes of

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* Dr. B. Biswas tells me the name is valid under Article 19a of International Code of Zoological Nomenclature.

brucei were not different from the nominate form.

Considering Hume's remarks mentioned above, together with further observations, *brucei* becomes an intermediate form which is really inseparable from nominate *poioicephala* and therefore a synonym.*

The birds from further north however i.e. Surat Dangs, and eastwards through Jabalpur, Hoshangabad, Bastar and Orissa into Sankrametta and Anantgiri in the Eastern Ghats, and southwards into the Shevaroy and Chitteri Hills are definitely paler and merit separation from the nominate form.

The material available in Bombay does not include large enough series from any particular place to permit determination if the differences in colour are not individual variations and remove the possibility that birds of a particular plumage have not been picked out and retained at other museums when the collections were studied by earlier workers.

Recently (March 1983) I put this problem to Dr. B. Biswas when he was in Bombay and on his recommendation was about to separate the birds from the northwest end of the Eastern Ghats as a paler form but a last look-over showed one from near R. V. Nagar, Vizagapatnam District, almost as dark as the southwest form! I am leaving this matter alone until there has been an opportunity of examining a really representative series from any one place.

The name *brucei* is omitted but the paler birds are listed separately above.

Measurements on p. 367.

1390 **Alcippe poioicephala poioicephala** (Jerdon) (Coonoor Ghat, Nilgiris) Nilgiri Quaker Babbler 1:277

29: 18 ♂♂ 10 ♀♀ 1 o?

5 Khandala, 1 near Koyna River, 1 Matheran, 1 Khaneri, Bombay, 1 Nagothna, Kolaba District, 1 Dhanapur, Ratnagiri; 3 Molem, 1 Valpoi, Goa; 1 Kadra, N. Kanara, 1 Honnametti, 1 Shenemenalla, 2 Bellaji, Biligirirangan Hills, Coorg, Karnataka; 1 Cooly Ghat, 1 Kattamalai, Gudalur, 1 Longwood Estate, Kotagiri, 1 Avalanche, 1 Coonoor, Nilgiris; 2 Santhanpara, Cardamom Hills, 1 Shembagnur, Palni Hills, 1 Palni Ghat, T.N.; 1 no data.

The male and female from Santhanpara, Cardamom Hills, south of Nilgiris, have the most rufous underparts and if this difference is found to be consistent and not repeated in the Nilgiri birds, they could also be separated.

Measurements on p. 367.

1391 **Alcippe poioicephala fusca** Godwin-Austen (Naga Hills) 1:278 (part)

3: 1 ♂ 1 ♀ 1 o?

2 N. Cachar; 1 *N' Krang, Upper Burma.*

The adults were collected by Stuart Baker in 1892 and 1893 and though the grey on the head and nape has almost disappeared, the upperparts are mainly rufous, with the underparts more strongly tinged with rufous than in any of the others.

The unsexed bird, possibly immature, obtained by Harington at N'Krang, Upper Burma, in July 1900 agrees very closely in colour, but is perhaps less rufous below.

Measurements on p. 367.

EL **Alcippe poioicephala karenni** Robinson & Kloss (Karenni, Upper Burma) Karenni Quaker Babbler

1 o? *Loi Kane, Karenni, Burma.*

The original label is marked "S. Shan States *magnirostris*" i.e. (of Walden) which is now synonymised with *karenni.*

Measurements on p. 368.

EL. **Alcippe poioicephala phayrei** Blyth (Arakan) Arakan Quaker Babbler 1:278

5: 1 ♂ 3 ♀♀ 1 o?

2 *Nyannggyo,* 1 *Prome Road, Prome District,* 1

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* See footnote on p. 358.

Kyilin, Henzada District, 1 *Sandoway District, Burma.*

Measurements on p. 368.

EL **Alcippe poioicephala haringtoniae** Hartert (Bhamo) Upper Burma Quaker Babbler 1:280

1 o? *North Shan States, Burma.*

Measurements on p. 368.

1392/3 **Alcippe nipalensis nipalensis** (Hodgson) (Nepal) Nepal Quaker Babbler 1:275

25: 14 ♂♂ 8 ♀♀ 3 o?

1 Martam, Rongni Valley, 1 Singhik, Sikkim; 2 Tama, 1 Mongdechu, Central, 1 Deothang, 1 Wamrong, East Bhutan; 1 Dafla Hills, 1 Dibang Valley, Mishmi Hills, 1 Dibrugarh, 2 Margherita, Assam; 2 Kolaktang, 1 Miao, 3 Hornbill Camp, Tirap Division, Arunachal Pradesh; 1 Kongpokpi, Manipur; 1 Makokchung, Naga Hills; 2 North Cachar; 2 *Hai Bum, Chindwin;* 1 *Mooktum, Upper Burma.*

The last three from Hornbill Camp, Tirap, A. P. collected in December 1981 show a distinct yellow wash on the underparts which is missing in all the others including 3 taken at Miao and Kolaktang(2) in 1978/9. The olive green of the back also becomes tinged with rufous and is in a few years of quite a different colour. The extent of rufous on the underparts also varies appreciably and the grey of the head disappears almost completely.

Ripley's *commoda* from Dening, Mishmi Hills, N. E. Assam, is now synonymised with the nominate race.

Measurements on p. 368.

1394 **Alcippe nipalensis stanfordi** Ticehurst (Taungup-Prome Cart Road, Arakan Yoma, 2900′) Chin Hills Quaker Babbler 1:275 (part)

4: 1 ♂ 3 o?

2 *Mt. Victoria, Pakokku District;* 2 *Nyannggyo, Prome District, Burma.*

These birds have less grey on the head than most specimens of *nipalensis* but are barely separable. They are marked *stanfordi* by Ticehurst.

Measurements on p. 368.

1395 **Heterophasia annectens annectens** (Blyth) (Darjeeling) Chestnutbacked Sibia 1:300

3: 1 ♀ 2 o?

1 Mishing, Abor Country, Mishmi Hills; 1 Embiong, Tirap Division, A.P.; 1 *Loison, N. Shan States.*

The central tail feathers are missing in one but not tipped with white as stated in IND. HANDBOOK (7 p. 128) and also in Stuart Baker's FAUNA (1 p. 301).

The chestnut on the lower belly and flanks varies appreciably being deepest in No. 2930 from Mishing, Abor Country.

Measurements on p. 368.

1396 **Heterophasia capistrata capistrata** (Vigors) (Himalayas, restricted to Simla by Ripley) Western Blackcapped Sibia 1:296

30: 15 ♂♂ 9 ♀♀ 6 o?

These fall into two groups.

(a) 17: 7 ♂♂ 7 ♀♀ 3 o?

1 Dunga Gali, Pakistan; 1 Dalhousie, Gurdaspur; 8 Simla, 1 Koti State, H.P.; 2 Lambathach, 2 Dakuri, 1 Ghat Gharwal, 1 Gharwal.

These birds from Gharwal and westwards are generally paler than (b), particularly at the collar round the neck.

(b) 13: 8 ♂♂ 2 ♀♀ 3 o?

2 Dhanaulti, Mussoorie, 5 Dakuri, 1 Mornaula, 1 Chirra, Kumaon; 1 Yoshinath, 1 Ghat Gharwal, 2 Ranibag, U.P.

According to the accepted distribution of races, these should be of the same race as (a) but they are on an average appreciably darker, though specimens from Ghat Gharwal fall into both groups. There is no difference in the measurements.

Considerable confusion has been caused by the change of type localities.

Measurements on p. 368.

1397 **Heterophasia capistrata nigriceps** (Hodgson) (Nepal, restricted to Central Nepal by Ripley) Nepal Blackcapped Sibia 1:296 (part)

2: 1 ♂ 1 ♀

1 Thumsi, 1 Muktesar, Nepal.

The latter has almost no grey or brown on the middle of the back and was collected by Major H. J. Walton on 11 July 1899, who has collected others listed under 1396(b) in April, May and June 1899, in Ghat, Yoshinath and Garhwal. The original label does not exist and the place name may be in error for Mukteshwar near Naini Tal, the bird only showing the variation visible under the nominate form.

Measurements on p. 368.

1398 **Heterophasia capistrata bayleyi** (Kinnear) (Taktoo, near Sakdan, E. Bhutan) Eastern Blackcapped Sibia

16: 8 ♂♂ 7 ♀♀ 1 o?

3 Kurseong, 2 Longview, Darjeeling, 2 Kewsing, Temi, West, 1 Lachung, North, 1 Ranjit Valley, Sikkim; 1 nr. Punthsholing, West, 1 Tama, 1 Tongsa, 1 Shamgong, 1 Batase, Central, 1 Wamrong, 1 Narphong, 1 Bhutan.

This is a very distinct race, separated by its smaller size and dark ashy back.

Measurements on p. 368.

1399 **Heterophasia gracilis** (McClelland) (Assam, restricted to Naga Hills) Grey Sibia 1:298

8: 3 ♂♂ 2 ♀♀ 3 o?

3 Kohima, Naga Hills, 1 Bishenpur, Manipur; 3 *Mt. Victoria, Burma;* 1 o? Place No. 3. 14.3.1907. Collected by Nipagoo ?

Measurements on p. 369.

1400 **Heterophasia pulchella** (Godwin-Austin) (Kunho Peak, Eastern Barail Range, Naga Hills) Beautiful Sibia 1:302

4: 3 ♂♂ 1 o?

1 Bomdila, Arunachal Pradesh; 1 Etalin, 1 Endoling, Mishmi Hills, 1 Naga Hills.

Measurements on p. 369.

1401 **Heterophasia picaoides picaoides** (Hodgson) (Nepal) Longtailed Sibia 1:295

12: 7 ♂♂ 4 ♀♀ 1 o?

1 Balasum, 3 Kurseong, 1 Longview T. E., Darjeeling; 1 Bhutan Duars, 3 Deothang, E. Bhutan; 3 Mishing, Abor Country, Mishmi Hills.

Measurements on p. 369.

EL **Heterophasia picaoides cana** (Riley) Doi Ang Ka Lat 18°35′ N, Long 98°30′ E Thailand)

3 o?: 1 *Loi Len,* 1 *N. Shan States,* 1 *Upper Burma.*

The tails are shorter than in the nominate form but ♀ No. 1431 from Darjeeling has a frayed tail measuring only 172 mm. The three Burmese birds are brown above rather than dark greyish brown, but the same colour is displayed by a few under nominate *picaoides.*

Measurements on p. 369.

EL **Heterophasia melanoleuca melanoleuca** (Blyth) (Mulayit Hill, Tenasserim) Tickell's Sibia 1:299

5: 1 ♀ 4 o?

1 *Chatarshu,* 1 *N. Shan States;* 2 *Sintaung, Taunggyi,* 1 *S. Shan States.*

The two from Sintaung, Taunggyi, collected in 1921 and 1933 have noticeably darker upperparts and their tails tipped white *contra* grey in the others. Ticehurst 1940 (*JBNHS* 41 p. 583) refers to the subspecies described from Burma and decides that *melanoleuca,* and *radcliffei* (Stuart Baker, N. E. Central Burma) are not separable, *melanoleuca* being a faded form of *radcliffei* — one obtained in 1923 and named *radcliffei* having become *melanoleuca* by 1940 (17 years). In the present series the pale birds are about 80 years old, while two dark ones though obtained 62 and 50 years ago are yet appreciably darker than the others.

The wings are longer and the tails shorter than indicated in Stuart Baker's Fauna.

Measurements on p. 369.

1333 **Leiothrix argentauris argentauris**

	Wing	Bill	Tarsus	Tail
♂♂ (10)	71-77 av. 75.5	14-16.5 av. 15.5	21.6-25.5 av. 23.6	62-69 av. 64.7
	(IH 70-81	17-19 from skull	24-26	63-72)
♀♀ (9)	72-76 av. 73.6	14.3-16.3 av. 15.4	20-24.2 av. 22.2	62-70 av. 65
	(IH 70-78	17-18 from skull	23-24	63-70)
o? (8)	70-80 av. 74.3	14.5-15.7 av. 15.1	20.2-24.6 av. 22.5	62-65 av. 64

1335/37 **Leiothrix lutea** subspp.

♂♂				
1335 *kumaiensis* (4)	70-75	13.9-15.5	21.4-24.3	54-60
	(IH as in 1336/7)			
1336/7 *calipyga* (4)	66(3), 69	11.8, 13, 13.6, 14	23.2, 26, 26.5, 27.2	54 (2), 56, 58
	(IH 65-72	14-16 from skull	25-28	55-59)
♀♀				
1335 *kumaiensis* (3)	67, 71, 74	12.2, 13.2 (2)	23.2, 23.6, 26	54, 57, 59
	(IH as in 1336/7)			
1336/7 *calipyga* (5)	67-72 av. 69.6	12.4-14.8 av. 13.6	23-27.7 av. 24.6	50-58 av. 55
	(IH 65-70	14-16 from skull	24-26	53-58)

1338 **Myzornis pyrrhoura**

♂♂ (4)	60, 60, 62, 64	14.1, 14.4, 15.3, —	21.1, 21.6, 22.5, 23.5	45, 45, 46, 47
	(IH 5 ♂♂ 57-63	15-16 from skull	23-24	45-48)
♀♀ (3)	58, 60, 61	14, 15, 15.4	20.6, 21.6, 23	43, 43, 45
	(IH 8 ♀♀ 56-62	13-18 from skull	23-24	40-47)

1339 **Cutia nipalensis nipalensis**

♂♂ (7)	92-100 av. 95.2	18.8-20.5 av. 19.7	25.6-30.3 av. 27.9	54-60 av. 57.8
	(IH ♂♂ 88-101	20-23 from skull	30-33	53-66)
♀♀ (4)	86, 88, 90 (2)	18.3, 18.6, 18.7, 19	25, 26, 28	55, 55, 57, 60
	(IH ♀♀ 83-93	19-21 from skull	27-30	56-60)

1340 **Pteruthius rufiventer**

♂♂ (2)	88, 90	19.5, 20	28.1, 28.5	80, 83
	(IH ♂♂ 85-90	20-22 from skull	29-31	80-84)

1341/EL **Pteruthius flaviscapis** subspp.

♂♂				
1341 *validirostris* (16)	80-87 av. 83.5	15.4-18.3 av. 16.7	23.2-28 av. 24.9	51-66 av. 58.4
	(IH ♂♂ 78-86	18-20 from skull	27-30	59-64)
EL *aeralatus* (1)	85	15	20.8	60
	(75-81	—	—	—)
♀♀				
1341 *validirostris* (20)	78-87 av. 82.7	15-19.3 av. 17.1	22-28 av. 25.5	55-64 av. 58.6
	(IH ♀♀ 78-87	17-20 from skull	27-29	57-66)
EL *aeralatus* (2)	78, 84	16, 16.3	24.3, 25	54, 59

1342-1343 **Pteruthius xanthochlorus** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1342 *occidentalis* (2)	65, 66	11, 12.8	19.5, 20.5	45, 47
	(IH as in 1343)			
1343 *xanthochlorus* (2)	64, 66	11.8, 12,	20, 20.5	46 (2)
	(IH ♂♂ 60-64	12-13 from skull	20-23	45-49)
♀♀				
1342 *occidentalis* (1)	63	12.5	21	45
	(IH as in 1343)			
1343 *xanthochlorus* (1)	62	11.1	19	45
	(IH 58-64	12 from skull (1)	22 (1)	45(1))

1345 **Pteruthius melanotis melanotis**

♂♂ (4)	58, 60, 61, 64	10.9, 11.5(2), 12	18.1, 18.8, 19, 19.5	40, 40, 43, 43
	(IH ♂♂ 55-63	11-12 from skull	20-22	30-45)
♀♀ (2)	57, 59	11.5, 12.3	19.5, 20.5	39, 40
	(IH ♀♀ 56-59	11-13	20-22	38-42)

1347 **Gampsorhynchus rufulus rufulus**

♂♂ (5)	94-97 av. 95.8	19.5-20.6 av. 19.9	25-28 av. 26.7	103-109 av. 105.6
♀♀ (5)	94-97 av. 95.8	18.5-20 av. 19.4	26-28.5 av. 27	101-113 av. 106.4
o? (3)	94, 95, 97	19.3, 20.5, 21	26, 27.5, 28	102, 106, 108
	(IH ♂♀ 90-100	20-21	26-31	110-120)
Immatures				
♂♂ (3)	92, 93, 97	19.5, 20, 20.5	25.6, 26.8, 27.8	93, 103, 106
♀♀ (2)	95, 97,	19.8, 20.5	26.2, 28	103, 110
o? (2)	91, 95	19, 19.6	24.2, 26.5	95, 106

1348/51 **Actinodura egertoni** subspp.

♂♂				
1348 *egertoni* (3)	86, 88, 89	16, 17.2 (2)	28.3, 28.7, 31.5	103, 112, 114
	(IH ♂♀ 79-90	from skull 17-19	29-33	93-115)
1349 *lewisi* (2)	81, 90	17.3, 17.5	27.5, 27.5	93, 108
	(IH 4 ♂♂ 81-90	from skull 20	29-31	104-116)
1349a subsp ? (1)	86	19	29	106
1350 *khasiana* (1)	85	18	28.5	108
	(IH measurements as in 1349)			
♀♀				
1348 *egertoni* (3)	80, 81, 84	16.2, 16.6, 17	28.3, 30, 31	91, 107, 110
1349 *lewisi* (4)	85, 88(2), 90	15.7, 16.5, 17.1, 17.5	27.6, 28.5(2), 29.5	96, 106, 112, 113
	(IH 8 ♀♀ 81-90	from skull 20	29-31	104-116)
1349a subsp ? (2)	87 (2)	18.2, 18.8	29, 30.5	102, 113
1350 *khasiana*	81, 86	16.5, 17.5	27.7, 29	98, 106
	(IH as in 1349)			
1348 *egertoni* (2) o?	82, 87	16.3	28.6, 31	103, 113
1349 *lewisi* (1) o?	87	16	26.7	106

	Wing	Bill	Tarsus	Tail
1351 *ripponi* (5) o?	81-92 av. 89	17.5-19.4 av. 18.4	26-30.5 av. 28.7	102-111 av. 108.2
	(IH 10 ♂♂ 86-93			
	3 ♀♀ 83-90	—	—	—)

1352/1356 **Actinodura nipalensis** subspp.

♂♂				
1352/53 *nipalensis* (4)	91, 93(2), 94	17.2, 19.1, 19.2, 20	30.6 (2), 31, 31.5	82, 84 (2), 86
	(IH 90-96	from skull 21-22	31	82-84)
1355 *waldeni* (1)	91	18	31.5	76
	(IH 89-97	from skull 21	31	79)
♀♀				
1352/53 *nipalensis* (4)	87 (3), 88	18.6, 18.9, 19.5, 20.1	27.2, 27.3, 28.5, 29.5	75, 78, 80, 81
	(♀♀ 83-97	from skull 21-22	—	77-80)
1354 *daflaensis* (2)	89, 90	17.2, 18.2	30.1, 30.5	78, 80
	(IH as in 1335	—	—	—)
o? 1352/53 *nipalensis* (1)	91	18.8	27.8	83

1357 **Minla ignotincta ignotincta**

♂♂ (13)	61-68 av. 64.5	11.2-14 av. 12.8	17.3-21.5 av. 19.2	52-59 av. 54.6
	(IH 63-70	from skull 12-14	20-22	52-58
♀♀ (8)	60-65 av. 63	11-13.7 av. 12.5	17-8-21 av. 19	50-55 av. 52
	(IH 59-66	from skull 12-14	19-21	51-58)

1358/61 **Minla strigula** subspp.

	Wing	Bill	Tarsus	Tail
♂♂				
1358 *simlaensis* (7)	67-71 av. 69.1	13.2-14.3 av. 13.6	21.6-25 av. 23.4	64-70 av. 67.9
		(IH as in 1359)		
1359 *strigula* (9)	65-71 as. 68.5	12.9-14 av. 13.3	23-25.5 av. 24.3	65-72 av. 67.6
	(IH 65-76)	from skull 12-16	25-28	66-75)
♀♀				
1358 *simlaensis* (7)	65-70 av. 68.4	12.7-14.5 av. 13.8	21.6-25 av. 23.6	65-70 av. 68.1
	(IH as in 1359)			
1359 *strigula* (4)	65-68	13.5 (2) 13.6	22.5-24.2	63-70
	(IH 63-69	from skull 13-15	26-28	67-68)
1361 *cinereigenae* (1)	64	13.5	23.5	64
	(IH 7 ♀♀ 63-67	from feathers 12-13	—	64-69)
1358 *simlaensis* (2) o?	65, 69	X, 12.3	23.2, 24.5	X, 65
1359 *strigula* (2) o?	66, 69	13 (2)	21.2, 24.6	66, 67
1360 *yunnanensis* (2) o?	69, 70	13.6, 14.5	22.2, 22.9, 23.5	64, 67, 70

1362 **Minla cyanouroptera cyanouroptera**

♂♂ (7)	62-68 av. 64.8	11.5-15 av. 13.4	20-23.1 av. 21.4	63-68 av. 65
*(2)	62, 63	13.8, 14.6	20.3, 22	58, 61
	(IH ♂♂ 60-69	from skull 14-16	22-24	60-70)
♀♀ (7)	61-66 av. 63.4	13-14.5 av. 13.6	20.7-22.1 av. 21.3	63-68 av. 64.8

	Wing	Bill	Tarsus	Tail
*(8)	59-64 av. 61.6	13.8-15.2 av. 14.5	18.8-22.1 av. 21	59-66 av. 62.2
	(IH 60-67	from skull 14-16	22-24	65-68)
(3) o?	61, 62, 63	12.8, 14.2, 15	18, 21, 22	60, 66, 66
*(4) o?	63 (4)	13.0, 13.7, 14.5 (2)	20.2, 21, 24.5, 25	63, (2), 64, 65
	*Underbelly sullied greyish			
EL. **Minla cyanouroptera wingatei**				
(4) o?	61, 63 (2), 64	13.5 (2), 14, 14.3	18, 21.3, 21.7(2)	63 (2), 65 (2)
(as in *M. c. cyanouroptera*)				
1363/65 **Yuhina castaniceps** subspp.				
♂♂				
1363 *rufigenis* (3)	60, 61, 65	9.5 11.5, —	12.5, 13, 16	48, 55, —
	(IH 4 ♂♀ 60-62	from skull 11-12	16-18	54-55)
1364 *plumbeiceps* (1)	60	10.7	15.9	52
	(IH 58-62	from skull 11	16	53-57)
1365 *castaniceps* (1)	60	11	16.5	55
	(IH as in 1364)			
♀♀				
1363 *rufigenis* (2)	59, 61	10.9, 11	15.9, 16.8	51, 54
1364 *plumbeiceps* (1)	61	9.5	13.6	53
	(IH 58-62	—	—	50-57)
1365 *castaniceps* (3)	54, 58, 65	11, 11.5, 11.8	14, 15, 17.2,	50, 53, 54
EL *striata* (2)				
♀ (1)	64	12	16	55
o? (1)	61	10	16	52
1366 **Yuhina bakeri**				
♂♂ (2)	69, 70	12.7, 12.8	21, 22.8	48, 50
	(IH 62-71	from skull 12-16	20-22	50-53)
♀♀ (5)	67-70 av. 69.4	12.2-13.7 av. 13.0	19.5-22.5 av. 20.9	44-50 av. 47.4
	(IH 65-72	from skull 11-13	20-23	46-50
1367/70 **Yuhina flavicollis** subspp.				
♂♂				
1367 *albicollis* (10)	59-67 av. 64.7	11.5-14.2 av. 12.9	17.6-20 av. 18.6	45-52 av. 49
	(IH as in 1368)			
1368/69 *flavicollis* (8)	61-65 av. 62.7	11.4-13.5 av. 12.1	18.6-20.6 av. 19.4	42-51 av. 46.6
	(IH 58-66	from skull 13-17	19-22	45-53)
♀♀				
1367 *albicollis* (7)	64-67 av. 64.5	12.3-13.2 av. 12.8	17.2-20.7 av. 19.3	46-52 av. 49.5
	(IH 58-66	from skull 12-15	19-22	45-54)
1368/69 *flavicollis* (12)	61-66 av. 62.5	11.4-13.3 av. 12.1	17.5-20.7 av. 19.5	43-49 av. 46.2
	12-15	(IH 58-66	19-22	45-54)

	Wing	Bill	Tarsus	Tail
1370 *rouxi* (1)	60 (IH as in 1368)	11.5	17.8	48
o? 1370 *rouxi* (6)	59-65 av. 62.6	11-7-13.1 av. 12.2	16.4-20.1 av. 18.4	46-50 av. 48.1
1372 Yuhina gularis gularis				
♂♂ (8)	72-80 av. 76.7 (IH 70-79	14.7-17 av. 15.9 from skull 17-19	20-23.6 av. 21.4 21-25	51-61 av. 58 53-63)
EL Yuhina diademata				
o? (1)	83	15.3	20	76
1373 Yuhina occipitalis				
♂♂				
a) (3)	64 (2), 65	14.9, 15, 15.4	18.5, 18.9, 19.2	49, 50, 51
b) (5)	64-67 av. 65.2	15.7-16.2 av. 15.9	19.1-20.4 av. 19.7	48-52 av. 50.2
♀♀				
a) (1)	62	15	19.7	49
b) (1)	65	16.6	21.2	50
	(IH ♂♀ 62-66	from skull 15-17	18-19	51-53)
1374 Yuhina nigrimenta nigrimenta				
♂♂ (6)	53-60 av. 56.5 (IH ♂♂ 52-59	12-13 av. 12.5 from skull 13-14	14.7-15.5 av. 15 16-18	35-39 av. 37.3 38-39)
♀♀ (8)	54-62 av. 58 (IH ♀♀ 53-59	11.7-12.7 av. 12.4 from skull 13-14	13.6-15.5 av. 14.3 *c.* 16	33-40 av. 37.7 36-39)
1375 Yuhina xantholeuca xantholeuca				
♂♂ (8)	61-69 av. 64 (IH 66-72	13.1-15 av. 13.9 from skull 14-15	13.6-17 av. 15 16-19	40-46 av. 43 44-49)
♀♀ (12)	60-67 av. 63 (IH 60-66	12.8-15 av. 13.8 from skull 14-15	13.5-16.6 av. 15.1 16-18	40-48 av. 42.4 42-47)
1376 Alcippe chrysotis chrysotis				
♂♂ (4)	51, 52, 54, 55 (IH 52-54	9.3, 9.5, 10, 10.3 from skull 10	18.5, 20.5 (2), 20.7 20-22	48, 49 (3) 46-49
♀ (1)	53 (IH 50-55	10.5 from skull 10	20 20-22	45 46-49
1378 Alcippe cinerea				
♂♂ (5)	56-58 av. 57	10.3-12.9 av. 11.6	20-21.3 av. 20.8	37-43 av. 41.2
♀♀ (4)	53 (2), 54, 58 (IH ♂♀ 51-58	11.4, 11.6, 12.1, 12.2 from skull 11-13	19, 19.7, 19.8, 20.2 20-23	36, 38(2), 39 38-44)

	Wing	Bill	Tarsus	Tail
	1379 **Alcippe castaniceps castaniceps**			
♂♂ (4)	56, 57, 58 (IH 56-61	10.8, 11.3(2), 11.7 from skull 12-13	18, 19, 19.6, 19.9 20-21	40, 42, 42, — 41-46)
♀♀ (10)	53-58 av. 55.3 (IH 50-56	10.1-11.1 av. 10.7 from skull 10-13	19-20.5 av. 19.6 20-21	39-43 av. 40.3 40-46)
	1380/82 **Alcippe vinipectus** subspp.			
♂♂				
1380 *kangrae* (4)	57-60 (IH 54-62	10.2-11.6 from skull 10-11	19.6-20.5 23-24	47-51 48-55)
1382 *chumbiensis* (8)	57-62 av. 59 (IH 56-62	9.3-11.2 av. 10.6 from skull 10-11	20.5-23.5 av. 21.8 23-24	48-55 av. 52.6 52-55)
♀♀				
1380 *kangrae* (3)	55-57 (IH 51-60	10.6-11.9 from skull 10-11	18.1-19.5 23-24	49-50 46-54)
1382 *chumbiensis* (8)	54-61 av. 57.7 (IH 58-62	10.4-11 av. 10.7 from skull 10-11	19.5-23.3 av. 21.6 23-25	46-55 av. 51.7 52-55)
	1387 **Alcippe rufogularis collaris**			
♂♂ (5)	53-59 av. 56.4 (IH 55-60	12.1-13.2 av. 12.6 from skull 13-14	19.3-21.2 av. 20.2 21	42-48 av. 45.8 46-49)
♀♀ (8)	50-58 av. 56.2 (IH 55-57	12.5-13.6 av. 12.9 from skull 13-14	18.6-21.3 av. 20.1 21	38-50 av. 45.1 46-47)
	1388 **Alcippe brunnea mandelli**			
o? (3)	56, 59, 60 (IH ♂♂ 57-61 ♀♀ 54-58	12.6, 12.8, 13.2 *c.* 14	27.7, 23, 23.2 *c.* 25	58, 62, 63 *c.* 60)
	1389/91+EL **Alcippe poioicephala** subspp.			
♂♂				
1389 *subsp?* (15)	66-76 av. 70.3 (1389 IH 66-77	13.8-15.8 av. 14.6 from skull 15-17	18.9-22.5 av. 20.9 21-24	63-68 av. 65.8 62-70)
1390 *poioicephala* (18)	66-74 av. 69.8 (IH 68-73	12.6-15.6 av. 14.3 from skull 15-16	18.5-22.8 av. 20.6 *c.* 23	59-69 av. 63.9 60-67)
1391 *fusca* (1)	69 (IH 67-72	15.2 from skull 15-17	19.6 21-22	64 63-70)

	Wing	Bill	Tarsus	Tail
EL. *phayrei* (1)	67	15	21.5	63
1389 ♀♀ *subsp*? (17)	61-72 av. 67.7	13.7-15.9 av. 14.5	18.9-22 av. 20.5	61-68 av. 63.9
	(1389 IH 66-74	from skull 15-16	21-23	59-70)
1390 *poioicephala* (10)	65-74 av. 69	13.2-15.5 av. 14.1	18.4-21.7 av. 20.5	61-67 av. 63.6
	(IH 65-75	from skull 15-16	*c.* 23	61-65)
1391 *fusca* (1)	67	15.1	19	61
	(IH ♀♀ 63-69	from skull 15-17	20-21	62-68)
EL *phayrei* (3)	64, 66, 67	13.5, 13.8, 15.1	18.5, 18.6, 20.9	61, 61, 61
EL *karenni* o? (1)	78	—	19.6	67
EL *haringtoniae* o? (1)	64	14.2	18.8	59
		1392/94 **Alcippe nipalensis** subspp.		
1392/93 *nipalensis* ♂♂ (14)	57-62 av. 60.9	11.2-12.9 av. 12.1	17-22.2 av. 19.6	50-58 av. 54.4
	(IH ♂♂ 57-63	from skull 13-15	22-24	57-66)
,, *nipalensis* ♀♀ (8)	57-63 av. 59.9	11-12.3 av. 11.8	18.2-21.6 av. 19.8	51-59 av. 54.9
	(IH ♀♀ 58-61	from skull 12-15	22-24	57-64)
1394 *stanfordi* ♂ (1)	60	11.7	18	56
	(IH measurements	as in 1392/93)		
.. *stanfordi* o? (3)	58 (3)	12.3, 12.5, 12.8	18.5 (2), 20.5	53 (2), 57
		1395 **Heterophasia annectens annectens**		
o? (1)	80	15.3	22.7	81
o? (2)	79, 85	15.2, 15.6	23.2, 23.2	78, 80
	(IH ♂♀ 75-84	from skull 15-16	*c.* 24	81-87)
		1396/98 **Heterophasia capistrata** subspp.		
1396 (a) ♂♂ *capistrata* (10)	97-108 av. 101.4	18.5-21.9 av. 20.0	24.1-32.4 av. 28.2	102-116 av. 110
	(IH ♂♂ 100-110)			
1396 (b) *capistrata* (8)	96-105 av. 101.7	19.6-21.6 av. 20.4	27.5-30 av. 28.7	104-110 av. 106
1397 *nigriceps* ♂ (1)	102	19.5	25.5	110
	(IH ♂♂ 88-102	from skull 22-24	*c.* 28	94-99)
,, *nigriceps* ♀ (1)	90	20.2	27	92
	(IH ♀♀ 89-93	from skull 22-24	*c.* 28	94-99)
1396 (a) *capistrata* ♀♀ (7)	96-107 av. 98.8	17.7-20.1 av. 18.9	25.7-29.6 av. 27.3	100-111 av. 103
1396 (b) *capistrata* ♀♀ (2)	95, 107,	18.4, 20.7	25.7, 28.7	96
	(IH ♀♀ 99-110)			
1398 *bayleyi* ♂♂ (8)	88-99 av. 93.8	20.1-21.5 av. 20.8	24.3-29.1 av. 27.1	91-112 av. 100
	(IH ♂♂ 88-101	from skull 22-23	28-31	102-107)
,, *bayleyi* ♀♀ (7)	89-93 av. 91.4	19.8-21.2 av. 20.6	25.2-28 av. 26	90-107 av. 98
	(IH ♀♀ 83-92	from skull 21-23	27-30	90-109)

1399 **Heterophasia gracilis**

♂♂ (3)	88, 91, 100	19.4, 20, 21.7	25, 28.6, 31	94, 103, 114
♀♀ (2)	92, 95	19, 19.3	27.7, 30	105, 107

1400 **Heterophasia pulchella**

	Wing	Bill	Tarsus	Tail
♂♂ (3)	95, 104(2)	20, 22.5, 22.8	28.7, 29.6, 30.2	102, 105, 110
	(IH 101-115	from skull 25	*c.* 30	113-118)
o? (1)	106	23.5	28.5	111

1401 **Heterophasia picaoides picaoides**

♂♂ (7)	107-128 av. 120.5	21.2-23.2 av. 22	25.5-28.6 av. 27	170-207 av. 191.7
♀♀ (4)	119, 120 (2), 121	21, 21.7 (2), 22.2	24.5, 26.6, 26.7, 29.2	172, 181, 190, —
	(IH ♂♀ 109-125	from skull 24-26	30-31	205-220)

EL **Heterophasia picaoides cana**

o? (4)	119, 120 (2), 122	19.2, 20.5, 21, —	24, 25.2, 26.1, 27.2	160, 172, 180, 192

EL **Heterophasia melanoleuca melanoleuca**

♀ (1)	94	17.5	26.5	105
o? (4)	91, 92, 95, 96	17.5, 18.2, 18.5, 18.9	24, 25.5, 26, 26.5	100, 102, 104, 111

(*to be continued*)

GRASSES OF UDAIPUR DISTRICT (RAJASTHAN STATE)[1]

S. S. Katewa and Y. D. Tiagi[2]

During a survey of the district of Udaipur over the last five years, we collected a total of 136 species of grasses. Out of these species 100 are new records for this district and 13 for the State of Rajasthan. The total number of the grass genera occurring in Udaipur district is 64. Of these 37 are panicoid and 27 pooid. The panicoid genera belong mostly to the tribes Andropogoneae and the Paniceae but the pooid genera are distributed among 13 tribes, 10 of which are monogeneric. Most of the Paniceae are hygrophillous. On the contrary, most of the Andropogoneae and Pooideae usually occur in dry places.

INTRODUCTION

The district of Udaipur, having an area of about 17267 sq. km. which is about 5.04 per cent of the total area of Rajasthan lies in the south-west of this state and is situated between 23°49′and 25°28′ N and 73°01′ and 75°49′ E. The Aravalli system of mountains dominates the tract which is characterized by unevenness. The eastern and north-eastern portion of the district is hilly containing long continuous ridges, as well as many detached hills, the whole physiography presenting a tangled wilderness of shallow valleys with an immense network of narrow 'nallas' (drains) and fairly deep gorges. The dominant rocks of the area belong to the Aravalli system, consisting of gneiss and Pre-Cambrian sandstones of the Vindhyan System. Here and there, especially in the Bansi, Dhariyawad and Salumber ranges, one can find isolated patches of Deccan trap. The soils in the plains are medium clayey, grey-brown, yellowish-red to red in colour In the hilly tracts, the soils are shallow and mostly consist of grit and coarse sand. On the Deccan trap black, clayey soils are prevalent. These also occur on other formations up to some distance around the traps. Alluvial sand occurs in the beds and on the banks of the rivers.

The district is drained by a network of several rivers and their tributaries. The main rivers are Banas, Baiarch, Khari, Jakham, Som, Sarsi, Jawai, Vakul and Sabarmati. There are several fresh water lakes in the district, prominent among which are Jaisamand, Udaisagar, Rajasamand, Peechola and Fatehsagar. The district has a tropical monsoon continental type of climate. The normal rainfall (1970-1979) is 594.79 mm. Most of the rainfall is received during the months of July, August and some in September and June. Sometimes winter showers, locally known as 'Mavata' are received during January and February. January is the coldest month when the average maximum temperature is only 27.5°C and the average minimum 3.1°C. The average maximum temperature during the month of May is 41.7°C which is the hottest month of the year whereas the average minimum temperature for May is 20.8°C. During the rainy season the average

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maximum temperature comes down to 36.1°C in July which further decreases to 34.0°C in August.

The flora of the different parts of the state of Rajasthan has been studied by a number of workers. A perusal of this literature reveals that the work on the systematics of grasses is meagre and sketchy. Only Ramchandran (1950), Gandhi *et al.* (1961), Prakash and Nanda (1961) and Kanodia and Rao (1965, 1966) have dealt exclusively with the grasses. Jain (1972) recorded the occurrence of *Arthraxon meeboldii* from Mount Abu. Recently, Bhandari (1978) described 90 species of grasses under 52 genera from the Thar desert. Sharma and Tiagi (1979) described 91 species under 53 genera in their Flora of North-East Rajasthan.

So far no systematic attempt has been made to study the grasses of Udaipur district which on account of its salubrious climate, floristically is perhaps the richest district of the state. The present work is an outcome of the geobotanical survey of the vegetation of the district of Udaipur. Collections were made during the period 1975 to 1980 in all the seasons of the year and data on phenology recorded. A set of these specimens have been deposited in the herbarium of Forest Research Institute, Dehradun and another in the Geobotany herbarium of Department of Botany, School of Basic Sciences and Humanities, University of Udaipur, Udaipur. The list is arranged according to Bor (1960). Nomenclatural changes proposed by Jain and Deshpande (1978) and Shukla and Jain (1978) have also been incorporated in the present work. The tribes of the Panicoideae and Pooideae are arranged in alphabetical order. Within each tribe the genera, within each genus the species, are arranged similarly in alphabetical succession. The number indicates sheet number for the family in the Geobotany Herbarium of this Department. Species with an asterisk are new records for the State of Rajasthan.

ENUMERATION OF GRASSES OF UDAIPUR DISTRICT

Tribe: ANDROPOGONEAE

1. *Andropogon* Linn.

Andropogon pumilus Roxb.
Common. Fl. & Fr.: October-November. Locality: Jhamarkotra, GBH 757.

2. *Apluda* Linn.

Apluda mutica Linn. var. **aristata** (Linn.) Pilger.
Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 953.

3. *Arthraxon* P. Beauv.

Arthraxon lancifolius (Trin.) Hochst.
Common grass on old walls of houses and forts.
Fl. & Fr.: August-October. Locality: Kumbhalgarh fort. GBH 314.

Arthraxon meeboldii Stapf
Rare. Fl. & Fr.: September-October. Locality: Baroi hill (Zawar Mines). GBH 743.

Arthraxon prionodes (Steud.) Dandy
Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 124.

4. *Bothriochloa* O. Ktze.

Bothriochloa pertusa (Linn.) A. Camus
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 366.

5. *Chrysopogon* Trin.

Chrysopogon fulvus (Spreng.) Chiov.
Common on stony soils with little water retaining capacity. Fl. & Fr.: September-November. Locality: University Campus. GBH 903.

6. *Cymbopogon* Spreng.

Cymbopogon jwarancusa (Jones) Schult
Common. Fl. & Fr.: September-November. Locality: University Campus. GBH 1059.

Cymbopogon martinii (Roxb.) Wats.
Common. Fl. & Fr.: September-November. Locality: University Campus. GBH 190.

Cymbopogon parkeri Stapf
Common. Fl. & Fr.: September-November. Locality: Matoon Mines. GBH 252.

7. *Dichanthium* Willm.

Dichanthium annulatum (Forssk.) Stapf
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 231.

Dichanthium aristatum (Poir.) C. E. Hubb.
Not common. Fl. & Fr.: August-September. Locality: University Campus. GBH 219.

***Dichanthium filiculme** (Hook.f.) Jain et Deshpande.
Rare. Fl. & Fr.: August-September. Locality: Hiran Magri, GBH 942.

***Dichanthium glabrum** (Roxb.) Jain et Deshpande.
Rare. Fl. & Fr.: August-October. Locality: University Campus. GBH 634.

Dichanthium huegelii (Hack.) Jain et Deshpande.
Common. Fl. & Fr.: August-September. Locality: Balaria hill (Zawar Mines). GBH 1040.

8. *Elyonurus* Humb. et Bonpl. ex Wild.

Elyonurus royleanus Nees ex A. Rich.
Common on open rocks. Fl. & Fr.: September-November.
Locality: Jhamarkotra. GBH 286.

9. *Eremopogon* (Hack.) Stapf

Eremopogon foveolatus (Del.) Stapf
Common. Fl. & Fr.: August-October. Locality: University Campus. GBH 156.

10. *Hackelochloa* O. Ktze.

Hackelochloa granularis (Linn.) O. Ktze.
Common. Fl. & Fr.: September-November. Locality: University Campus. GBH 487.

11. *Hemarthria* R. Br.

***Hemarthria altissima** (Poir.) Stapf et C. E. Hubb.
Rare. Fl. & Fr.: August-September. Locality: Fatehsagar, GBH 776.

Hemarthria compressa (Linn.) R.Br.
Common grass restricted to marshy places. Fl. & Fr.: August-September. Locality: Fatehsagar. GBH 41.

12. *Heteropogon* Pers.

Heteropogon contortus (Linn.) P. Beauv.
Common. Fl. & Fr.: September-November. Locality: University Campus. GBH 26.

13. *Imperata* Cyr.

Imperata cylindrica (Linn.) P. Beauv.
Common grass restricted to marshy places. Fl. & Fr.: August-October. Locality: Gulab Baugh, GBH 481.

14. *Ischaemum* Linn.

Ischaemum laxum R.Br.
Common. Fl. & Fr.: August-October. Locality: University Campus. GBH 464.

Ischaemum rugosum Salisb.
Common in wet marshy places especially in rice fields. Fl. & Fr. : September-October. Locality : Gorana Dam. GBH 966.

15. *Iseilema* Anderss

Iseilema laxum Hack.
Common. Fl. & Fr. : August-September. Locality : Gorana Dam. GBH 934.

Iseilema prostratum (Linn.) Anderss
Common near stagnant water. Fl. & Fr. : September-October. Locality : Gorana Dam. GBH 598.

16. *Rottboellia* Linn.f.

Rottboellia exaltata Linn.f.
Common grass with stiff hairs on the leaves and sheaths. Fl. & Fr.: September-October. Locality: Balaria Hill (Zawar Mines). GBH 328.

17. *Saccharum* Linn.

Saccharum officinarum Linn.
Common. Fl. & Fr. : February-March. Locality : Agriculture College Campus. GBH 1035.

Saccharum spontaneum Linn.
Not common. Fl. & Fr. : October-February. Locality : Kewara-ke-nal. GBH 768.

18. *Sorghum* Moench

Sorghum conspicum Snowden
Common. Fl. & Fr. : September-October. Locality : University Campus. GBH 993.

Sorghum deccanense Stapf
Not common. Fl. & Fr. : September-October. Locality : Railmagra. GBH 710.

Sorghum halepense (Linn.) Pers
Common. Fl. & Fr. : September-October. Locality : University Campus. GBH 706.

Sorghum miliaceum (Roxb.) Snowden.
Common. Fl. & Fr. : September-October. Locality : University Compus. GBH 709.

Sorghum vulgare Pers
Common. Fl. & Fr. : September-October. Locality : University Campus. GBH 989.

19. *Themeda* Forssk.

Themeda quadrivalvis (Linn.) O. Ktze.
Common. Fl. & Fr. : September-October. Locality : University Campus. GBH 338.

20. *Vetiveria* Lem. Lisanc.

Vetiveria zizanioides (Linn.) Nash
Common on moist areas in thick tufts. Fl. & Fr. : November-January. Locality : Kailashpuri. GBH 849.

Tribe: MAYDEAE

21. *Coix* Linn.

Coix lacryma-jobi Linn.
Rare in wet places along streams. Fl. & Fr.: September-October. Locality: Gorana Dam. GBH 978.

22. *Zea* Linn.

Zea mays Linn.
Common. Fl. & Fr. September-October. Locality : University Campus. GBH 439.

Tribe: PANICEAE

23. *Alloteropsis* J. S. Presl

Alloteropsis cimicina (Linn.) Stapf
Common. Fl. & Fr. : August-September. Locality : Balaria Hill (Zawar Mines). GBH 656.

24. *Brachiaria* Griseb.

Brachiaria eruciformis (J.E.Sm.) Griseb.
Common. Fl. & Fr. : September-November. Locality : Vallabh nagar. GBH 577.

Brachiaria ramosa (Linn.) Stapf
Common. Fl. & Fr.: August-September. Locality: M. B. College Campus. GBH 1045.

Brachiaria reptans (Linn.) Gard. et C. E. Hubb.
Common. Fl. & Fr.: July-September. Locality: M. B. College Campus. GBH 691.

Pseudobrachiaria deflexa (Schum.) Launert.
Common. Fl. & Fr.: August-September. Locality: Gorana Dam. GBH 1028.

25. *Cenchrus* Linn.

Cenchrus ciliaris Linn.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 606.

Cenchrus setigerus Vahl
Common. Fl. & Fr.: October-November. Locality: M. B. College Campus. GBH 607.

26. *Digitaria* Heist. ex Fabricius

Digitaria ciliaris (Retz.) Koel.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 765.

***Digitaria bicornis** (Lamk.) Roem.
Common. Fl. & Fr.: August-September. Locality: Gulab Bagh. GBH 772.

Digitaria adscendens (Roem. et Schult.) Veldk.
Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 43.

Digitaria setigera Roth
Rare. Fl. & Fr.: August-September. Locality: Gulab Bagh. GBH 246.

Digitaria stricta Roth
Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 44.

27. *Echinochloa* P. Beauv.

Echinochloa colonum (Linn.) Link.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 1003.

Echinochloa crusgalli (Linn.) J. Beauv. var. **crusgalli**
Rare emergent grass. Fl. & Fr.: August-September. Locality: Fatehsagar. GBH 502.

Echinochloa crusgalli (Linn.) P. Beauv. var. **submutica** Neilr.
Common. Fl. & Fr.: August-September. Locality: Zawar Mines. GBH 494.

Echinochloa stagnina (Retz.) P. Beauv.
Common. Fl. & Fr.: August-September. Locality: Zawar Mines. GBH 432.

28. *Eriochloa* Kunth

Eriochloa procera (Retz.) C. E. Hubb.
Common along river banks. Fl. & Fr.: September-October. Locality: Tidi river. GBH 676.

29. *Oplismenus* P. Beauv.

Oplismenus burmannii (Retz.) P. Beauv.
Common in shady places. Fl. & Fr.: August-September. Locality: Kumbhal garh. GBH 568.

30. *Panicum* Linn.

***Panicum cambogiense** Balansa
Rare. Fl. & Fr.: September-October. Locality: Hiran Magri. GBH 854.

Panicum maximum Jacq.
Not common. Fl. & Fr.: August-September. Locality: Gorana Dam. GBH 998.

Panicum miliaceum Linn.
Common. Fl. & Fr.: August-September. Locality: Gulab Bagh. GBH 922.

Panicum paludosum Roxb.
Common grass with spongy culms, found on margins of slow flowing streams and puddles. Fl. & Fr.: August-October. Locality: Gorana Dam. GBH 958.

Panicum trypheron Schult.
Common. Fl. & Fr.: August-September. Locality: Gorana Dam. GBH 739.

31. *Paspalidium* Stapf

Paspalidium flavidum (Retz.) A. Camus
Common in moist places. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 530.

Paspalidium geminatum (Forssk.) Stapf
Common along the banks of rivers and ponds. Fl. & Fr.: July-October. Locality: Fatehsagar. GBH 292.

32. *Paspalum* Linn.

Paspalum dilatatum Poir.
Common along the margins of sewage channels. Fl. & Fr.: July-October. Locality: Ayad nallah. GBH 683.

Paspalum paspaloides (Michx.) Scribn.
Common along the margins of sewage channels. Fl. & Fr.: July-October. Locality: Ayad nallah. GBH 1016.

Paspalum vaginatum Swartz.
Common. Fl. & Fr.: July-October. Locality: Agriculture College Campus. GBH 1011.

33. *Pennisetum* Rich.

Pennisetum hohenackeri Hochst. ex Steud.
Commonly found in clumps on muddy places. Fl. & Fr.: August-September. Locality: On way to Bari. GBH 785.

Pennisetum hordeoides (Lamk.) Steud.
A very characteristic common grass growing along the road side with purplish inflorescence. Fl. & Fr.: September-October. Locality: Kevera-ke-Nal. GBH 819.

***Pennisetum orientale** L.C. Rich.
Rare. Fl. & Fr. July-October. Locality: Jaisamand. GBH 590.

Pennisetum pedicellatum Trin.
A common grass of rocky ground conspicuous from its pink inflorescence. Fl. & Fr.: September-October. Locality: Kavera-ke-Nal. GBH 782.

Pennisetum purpureum Schumach.
Rare in this area, found growing in muddy places. Fl. & Fr.: September-October. Locality: Behind T.S.V. Hostel. GBH 718.

Pennisetum typhoides (Burm.) Stapf et C. E. Hubb.
Common, Fl. & Fr.: August-October. Locality: Durga Nursery. GBH 981.

34. *Pseudoraphis* Griff.

Pseudoraphis spinescens (R. Br.) Vickery
Not common, found rooting in shallow water and floating upon the surface of inland slow-moving rivers and in lakes. Fl. & Fr.: August-September. Locality: Gorana Dam. GBH 970.

35. *Rhynchelytrum* Nees

Rhynchelytrum repens (Willd.) C. E. Hubb.
Common on stony soils with pink feathery panicles Fl. & Fr.: August-September. Locality: University Campus. GBH 714.

36. *Setaria* P. Beauv.

Setaria glauca (Linn.) P. Beauv.
Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 913.

Setaria italica (Linn.) P. Beauv.
Rare. Fl. & Fr: September-October. Locality: Gulab Bagh. GBH 672.

Setaria pallide-fusca (Schumach.) Stapf et C. E. Hubb.
Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 824.

Setaria intermedia Roem. et Schult.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 795.

Setaria verticillata (Linn.) P. Beauv.

Common with spikes readily sticking to ones clothing. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 474.

37. *Urochloa* P. Beauv.

Urochloa panicoides P. Beauv. var **velutina** (Henr.) Bor

Common. Fl. & Fr.: August-September. Locality: M. B. College Campus. GBH 888.

Group: POOIDEAE

Tribe: AGROSTIDEAE

38. *Polypogon* Desf.

Polypogon monspeliensis (Linn.) Desf.

Common. Fl. & Fr.: January-March. Locality: M. B. College Garden. GBH 539.

Tribe: ARISTIDEAE

39. *Aristida* Linn.

Aristida adscensionis Linn. var. **adscensionis**

Common. Fl. & Fr.: August-October. Locality: University Campus. GBH 382.

Aristida depressa Retz.

Common. Fl. & Fr.: September-October. Locality: Zawar Mines. GBH 973.

Aristida funiculata Trin. et Rupr. var. **funiculata**

Common. Fl. & Fr.: August-September. Locality: University Campus. GBH 418.

Aristida funiculata Trin. et Rupr. var. **mallica** (Edgew.) Henr.

Common. Fl. & Fr.: August-September. Locality: Zawar Mines, GBH 823.

Aristida setacea Retz.

Common. Fl. & Fr.: August-February. Locality: Zawar Mines. GBH 832.

Tribe: ARUNDINEAE

40. *Arundo* Linn.

Arundo donax Linn.

Not common. Fl. & Fr.: August-October. Locality: M. B. College Garden. GBH 277.

Tribe: AVENEAE

41. *Avena* Linn.

Avena fatua Linn. var. **glabrata** Peterm.

Common. Fl. & Fr.: January-February. Locality: Agriculture College Campus. GBH 754.

Avena fatua Linn. var. **pilosa** Syme

Common. Fl. & Fr.: January-February. Locality: Agriculture College Campus. GBH 948.

Tribe: CHLORIDEAE

42. *Chloris* Sw.

Chloris barbata Sw.

Common. Fl. & Fr.: August-October. Locacality: M. B. College Campus. GBH 633.

Chloris dolichostachya Lagasca.

Not common. Fl. & Fr.: August-October. Locality: Balaria hill (Zawar Mines). GBH 308.

Chloris montana Roxb.

Common. Fl. & Fr.: August-September. Locality: Zawar Mines. GBH 616.

Chloris quinquesetica Bhide

Not common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 936.

Chloris virgata Sw.

Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 625.

43. *Cynodon* Rich

***Cynodon barberi** Rang. et Tad.

Rare. Fl. & Fr.: July-October. Locality: Zawar Mines. GBH 812.

Cynodon dactylon (Linn.) Pers.
Common. Fl. & Fr.: Almost throughout the year. Locality: M. B. College Campus. GBH 791.

44. *Melanocenchris* Nees

Melanocenchris jacquemontii Jaub. et Spach.
Common. Fl. & Fr.: August-October. Locality: University Campus. GBH 509.

***Melanocenchris monoica** (Rottl.) C.E.C. Fisch.
Rare. Fl. & Fr.: August-October. Locality: Balaria hill (Zawar Mines). GBH 828.

45. *Oropetium* Trin.

Oropetium thomaeum (Linn. f.) Trin.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 123.

46. *Schoenefeldia* Kunth

Schoenefeldia gracilis Kunth.
Rare. Fl. & Fr.: August-October. Locality: Air Port. GBH 267.

47. *Tetrapogon* Desf.

Tetrapogon tenellus (Roxb.) Chiov.
Common. Fl. & Fr.: August-October. Locality: Balaria hill (Zawar Mines). GBH 468.

Tribe: ERAGROSTAE

48. *Acrachne* Wight et Arn.

Acrachne racemosa (Heyne) Ohwi
Common. Fl. & Fr.: July-September. Locality: M. B. College Campus. GBH 301.

49. *Dactyloctenium* Willd.

Dactyloctenium aegyptium (Linn.) P. Beauv.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 931.

Dactyloctenium sindicum Boiss
Common. Fl. & Fr.: September-November. Locality: M. B. College Campus. GBH 927.

50. *Desmostachia* Stapf

Desmostachia bipinnata (Linn.) Stapf
Common. Fl. & Fr.: October-January. Locality: University Campus. GBH 639.

51. *Dinebra* Jacq.

Dinebra retroflexa (Vahl) Panz.
Common in cultivated fields. Fl. & Fr.: September-October. Locality: Agriculture College Campus. GBH 447.

52. *Eleusine* Gaertn.

Eleusine coracana (Linn.) Gaertn.
Common. Fl. & Fr.: September-November. Locality: On way to Kumbhal garh. GBH 985.

Eleusine indica (Linn.) Gaertn.
Common. Fl. & Fr.: July-October. Locality: M. B. College Campus. GBH 175.

53. *Eragrostiella* Bor

Eragrostiella bifaria (Vahl) Bor
Common on stony soils. Fl.: August-September. Locality: University Campus. GBH 137.

Eragrostiella brachyphylla (Stapf) Bor
Common. Fl. & Fr.: August-September. Locality: University Campus. GBS 899.

54. *Eragrostis* P. Beauv.

Eragrostis cilianensis (All.) Vignolo-Lutati.
Not common. Fl. & Fr.: October-December. Locality: Airport. GBH 734.

Eragrostis ciliaris (Linn.) R. Br. var. **ciliaris**
Common. Fl. & Fr.: October-February. Locality: M. B. College Campus. GBH 1007.

Eragrostis ciliaris (Linn.) R. Br. var. **brachystachya** Boiss.
Common. Fl. & Fr.: October-February. Locality: On way to Kailashpuri. GBH 405.

Eragrastis diarrhena (Schult.) Steud.
Common. Fl. & Fr.: October-December. Loality: Vallabh Nagar. GBH 411.

Eragrostis gangetica (Roxb.) Steud.
Common. Fl. & Fr.: October-November. Locality: On way to Bari. GBH 896.

Eragrostis nigra Nees ex Steud.
Common. Fl. & Fr.: August-September. Locality: M. B. College Campus. GBH 1022.

Eragrostis minor Host.
Common. Fl. & Fr.: October-November. Locality: M. B. College Campus. GBH 862.

Eragrostis tenella (Linn.) P. Beauv.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 843.

Eragrostis tremula Hochst. ex Steud.
Common. Fl. & Fr.: August-October. Locality: University Campus. GBH 761.

Eragrostis unioloides (Retz.) Nees ex Steud.
Not common. Fl. & Fr.: November-January. Locality: Gorana Dam. GBH 962.

Eragrostis viscosa (Retz.) Trin.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 860.

55. *Leptochloa* P. Beauv.

***Leptochloa chinensis** (Linn.) Nees
Not common. Fl. & Fr.: August-September. Locality: M. B. College Campus. GBH 345.

***Leptochloa panicea** (Retz.) Ohwi
Not Common. Fl. & Fr.: August-September. Locality: M. B. College Campus. GBH 516.

56. *Tripogon* Roem. et Schult.

***Tripogon hookerianus** Bor
Not common. Fl. & Fr.: August-September. Locality: University Campus. GBH 564.

Tripogon jacquemontii Stapf
Common on rocky soils. Fl. & Fr.: August-September. Locality: Bari. GBH 805.

Tripogon roxburghianus (Steud.) Bhide
Common. Fl. & Fr.: August-October. Locality: University Campus. GBH 671.

Tribe: ORYZEAE

57. *Oryza* Linn.

Oryza sativa Linn.
Common. Fl. & Fr.: September-November. Locality: Zawar Mines. GBH 560.

Tribe: PEROTIDEAE

58. *Perotis* Ait.

Perotis indica (Linn.) O. Ktze.
Common. Fl. & Fr.: August-October. Locality: On way to Jhameshwarji. GBH 548.

59. *Phalaris* Linn.

Phalaris minor Retz.
Common. Fl. & Fr.: January-March. Locality: Agriculture College Campus. GBH 585.

Tribe: SPOROBOLEAE

60. *Sporobolus* R. Br.

Sporobolus coromandelianus (Retz.) Kunth.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 368.

Sporobolus diander (Retz.) P. Beauv.
Common. Fl. & Fr.: August-October. Locality: M. B. College Campus. GBH 391.

Sporobolus marginatus Hochst. ex A. Rich.
Common. Fl. & Fr.: October-December. Locality: Kailashpuri. GBH 375.

Tribe: TRITICEAE

61. *Hordeum* Linn.

Hordeum vulgare Linn.
Common. Fl. & Fr.: December-March. Locality: Agriculture College Campus, GBH 1052.

62. *Triticum* Linn.

Triticum aestivum Linn.
Common. Fl. & Fr.: January-March. Locality: Agriculture College Campus. GBH 446.

Tribe: ZOYSIEAE

63. *Tragus* Hall.

Tragus roxburghii Panigar.
Common. Fl. & Fr.: October-December. Locality: Ayad. GBH 454.

Tribe: BAMBUSEAE

64. *Bambusa* Schreb.

Bambusa bambos (Linn.) Voss
Common. Fl. & Fr.: Not seen. Locality: Balaria hill (Zawar Mines). GBH 1054.

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PEREGRINE FALCON[1]

S. M. OSMAN[2]

It has mainly been left to falconers to write about the life of the peregrine falcon, and make it known to the general public. Such knowledge of the peregrine as exists, has mostly if not exclusively come from the pen of falconers, because the best available information about these birds was evident to them long before modern ornithology got interested in falcons. From falconry we learn a great many things which could perhaps never have been known through other sources.

Falconers have written about other kinds of falcons also, yet the peregrine falcon and some of its subspecies have always remained a favourite with them, and in consequence more literature has been devoted to this group of noble birds. Since falconry enthusiasts have been able to study peregrine falcons very closely they have rightly been able to assess its intelligence and behaviour better than the modern scientific bird watcher whose contact with these falcons is generally through the medium of high powered binoculars. Ornithologists are likely to draw conclusions, by studying over a period of time, a single peregrine falcon. I feel it is incorrect to generalize from the observation of only a single or even just a few birds.

I have had first hand experience of quite a number of passage peregrines consisting of (a) *Falco peregrinus peregrinus*, (b) the Siberian falcon *F. p. calidus*, and (c) *F. p. brevirostris*[3] group of birds. In addition to this I have trained and hunted with many other subspecies of the peregrine. In all cases, their highly specific predatory behaviour, including choice of prey, manner of attacking and despatching the victim, their habits and reactions to certain types of stimuli while held under training, provide ample clues to their varying evolutionary adaptations and consequent intriguing problems relevant to the special sort of training and hunting regimen demanded in each case. My experiments with all the species/types, of the peregrine tribe, and other hawks also, have revealed and clearly demonstrated a common decisive influence: the trainer's first social approach bearing heavily on the predator's emotional behaviour.

Distributed all over the earth, there are twenty three kinds of peregrine falcons. This is really surprising, since it has all along been taken for granted that crowding instinct alone is mainly responsible for the promotion of interbreeding of species. Crowding as we can see is a factor controlled entirely by the mobility of a group. In view of the free and unfettered mobility at the peregrine's disposal, the very idea of interbreeding and subsequent evolution of subspecies, may appear to the casual observer, a bit far fetched. However the phenomenon can be explained and understood if we examine the problem carefully.

In all my experience with these birds, I have known three kinds of passage peregrines that breed near, or as in one case, inside the Arctic circle, and all these three fly down south to hunting grounds in the tropics every year in

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[1] Accepted December 1981.

[2] 11-D/10 Circular Road, Dehra Dun, U.P.

[3] This is one of the "forms" of *F. p. peregrinus* recognised by Menzbier 1892 — Eds.

the winter. Thus they freely migrate, from their breeding grounds to their winter quarters, and back, completing a double journey of almost ten thousand miles yearly. The three different types of passage peregrines that I have kept and trained vary little in size. Their respective colour schemes also vary but slightly. Their markings are similar and other characteristics more or less the same. Variation in size and colour is almost entirely caused by food habits and environmental factors and influences. Of the three peregrines mentioned above, *Falco peregrinus calidus* flies the longest distance every year. It breeds well within the Arctic circle, and flies down to and beyond the Persian Gulf as far south as Aden, every winter. Compared to the other two migratory peregrines I know, it is easily the biggest killer falcon.

Because of its signal killing capacity, this bird is highly prized by Arab falconers. There is an unending demand for it in the hawk markets of Kuwait and other Arab sheikdoms skirting the southern shores of the Persian Gulf. Rarely, I have seen stray birds turn up in the Punjab and the Indogangetic plain. During the past thirty years I have come across only four such falcons (*calidus*) that were trapped in the Punjab and western Uttar Pradesh. Detailed attention has been paid to this falcon elsewhere [See JBNHS Vol. 75 (3): 845-853]. Let us consider some of the factors responsible for the distribution and evolution of subspecies of the three distinct passage birds that have been mentioned earlier.

From time to time it has all along been observed by many falconers, and on many occasions I myself have also noticed it, that in certain years some individual passage peregrines will not fly back to breeding grounds from their wintering quarters. Twice I have seen adult passage peregrines in Mussoorie (W. Himalayas) during July; under normal conditions these very birds ought to have flown back to their northern breeding grounds early in March. One of the peregrines was sighted in the vicinity of Gun Hill on Camel's Back road. I saw it for the first time when I was taking a stroll along Camel's Back road one fine morning. I got interested, and just to make sure that it indeed was a peregrine falcon I had seen, I revisited the spot the next day in the hope of getting a better look at my friend, should it still be in the area. I could easily find her on my second visit, and I spent almost a full hour studying her through binoculars. She was a large female peregrine in her third moult, and from that I could make out she probably was of the form *brevirostris*. The falcon had chosen a rock perch towering high up above Camel's Back road, just above the Christian cemetery.

There was hardly any traffic on this particular road then, though the hill season was in full swing, so the bird was not disturbed by the presence of human beings and remained comparatively unafraid. I was thus able to climb close to her perch, and to observe her in an atmosphere of comparative calm for nearly an hour each time on two successive days.

Kites and crows did not disturb her at all, but a Shaheen tiercel appeared the first day I was keeping watch. With grating screeches, in mock attacks he stooped at the peregrine several times. I suppose he was just trying, with amorous intent, to get to know the lady from the north a little better, or perhaps wished to drive the interloper away from his territory. Whatever it may be, he failed miserably for I could see that the peregrine was not in the least bothered by the attention that was thus being paid her.

Incidentally I have on several occasions witnessed the ritual aerial 'dance' of some male and female falcons. First, at a height of almost five hundred feet above ground, the tiercel makes a few passes at the female falcon; then as both birds close in the female turns over on her back in midair and grabs the outstretched claws of the attacking tiercel, and thus with the claws locked together vehemently beating their wings and gyrating vigorously, both float down to eighty feet or so when they once again break apart.

In my opinion this aerial display, vocal and physical, serves to attract and appease both partners till eventually the pair gradually gets accustomed to each other and the bond is established. I have watched lagger falcons (*Falco jugger*) that have been together and breeding for three or four successive seasons. They rarely indulged in such noisy aerobatics, and this may be due to the fact that the birds were known to each other. Of course the occasional bouts of display may have caused the falcons to attain some sexual stimulation, as this kind of behaviour could definitely cause acceleration of sexual excitation and connected reproductive processes.

Broadly speaking there are two groups of falcons: one comprises of the peregrine and its subspecies, the other group consists of the Saker falcon (*Falco cherrug*) and Gyr falcon (*Falco rusticolus*) type of birds. In my opinion, as a falconer, the Gyr, the Saker, and the Merlin falcon (*Falco columbarius*) and *F. chicquera* are close relatives. In the Saker and the Gyr falcon a close similarity can be seen not only in size and shape, but also in the fact that in both these birds, after each successive moult, the configuration of the streaks or elongated spots on the underparts from crop to belly does not change appreciably. On the other hand in the case of true passage peregrine and some of its subspecies as well, breast, crop, belly and back markings undergo significant changes with each succeeding moult. The elongated breast spots become broad arrow heads, which later turn to bars as the falcon grows older. Feather edgings on wing-coverts and back disappear, and colour of the peregrine's head, as well as that of *peregrinator* falcons undergo perceptible changes.

For years I have off and on been keeping Saker falcons. Comparing these birds with Gyr falcon (I only mean pictures of the Gyr, since I have not had the pleasure of actually handling one of these singularly striking and noble birds) there is for all the world to see, yet another marked resemblance present. Toes in both these falcons, in proportion to their body size, are comparatively short and thick. The tarsus is also similarly short. It appears as if both these birds were intended by nature to be better adapted for perching on rocky outcrops and sand dunes in general. As for the tiny Merlin falcon (*Falco columbarius*) though there is a great difference in size between it and the Gyr or the Saker falcon, yet a significant character is common to all the three, namely, the tail pens or rectrices exceed the primary wing quills in length. This character is absent and lacking in the peregrine and all its subspecies. Also like its bigger cousin the Saker falcon, the Merlin does not change significantly after each moult. In addition if we compare the Merlin closely with the peregrines we will see that for a dainty little falcon of its size, its beak, like that of the Saker and the Gyr, is more broad based and powerfully built in proportion.

In places where the true passage Peregrine's wintering grounds overlap those of the Saker falcon, it is conceivable to me that on rare occasions when a Peregrine has not flown back to its nesting area, at the onset of the mating season, hybridisation of the two species may take place. This could have led to the production of the Lanner falcon which combines most of the Peregrine's attributes with some of the Saker's. Actually like the Saker the Lanner Falcon is also not a migratory bird though some modern scientists prefer to call it a Peregrine subspecies. Only a local shifting of the Lanner falcon from one hunting ground to another is in evidence. Again like the Saker, the Lanner is always in its element in arid country bordering on desert land. With the Lanner falcon there is no appreciable change in back and frontal markings after each moult.

I once had a trained Lanner falcon which remained with me for four years. After three moults I found no difference in its original front and back markings and in those it acquired after three successive moults. However, unlike its 'ancestor' the Saker, the Lanner falcon's method of hunting, its habit of soaring aloft and waiting for game to break cover, and finally to my mind, the way it runs down its quarry, mostly striking it in midair, definitely betrays a peregrine ancestory. Its beak also is not broad based like that of the Saker's but built more like a peregrine's. It has long toes totally unlike the short stubby toes of a Saker.

When the Lanner (*Falco biarmicus*) in turn met the passage peregrine, the red-naped Shaheen (*Falco pelegrinoides*) was born. This bird is more Peregrine than the Lanner, and ranges in an intermediate zone — not quite as far south as the Peregrine's farthest wintering limit, but in a belt that borders on the Lanner's northernmost range. In some places, like in Baluchistan (Pakistan), I have found them comfortably sharing a common territory. The red-naped Shaheen is smaller than the Peregrine falcon in size, an adult female weighing one and a half pounds. However it is very solidly formed, broad breasted, and with short secondary feathers. Its toes are long like those of a Peregrine. After every moult, there is a definite change noticeable in the markings on its breast and back, and in the colour of its head. In five or six year old birds this turns to a beautiful red tone, not unlike a Merlin falcon's head. I may add, however, that in the case of the Merlin falcon, the red extends down to the shoulder in juvenile birds, gradually recedes up the neck so that in five year old Merlins (and I refer to the redheaded Merlin) the head alone remains red in colour while the nape and shoulders turn grey. In the red-naped Shaheen falcon, the opposite is the case: as the bird gets older, first a red tint forms on top of its head which spreads progressively down its neck after each moult. The red-capped Shaheen is essentially a bird of scrublands and bare mountains. Local migration does take place when it flies to the nearest range of mountains for nesting. For example these falcons will be seen in winter in the Sindh valley, Pakistan, but they fly to the Sulaiman range of mountains to breed. This falcon seemingly having moved east of its most easterly limit, across the Indus river got to the Punjab area. It then started frequenting the Himalayas for nesting and breeding. In this part of the subcontinent the hills and plains directly below them are all luxuriantly wooded with pine and oak forests as a result of ample irrigation by snow fed streams and rivers from the Himalayas. Over a period of geological time, because of the local ecological conditions of such environment a dark phase of this falcon, the black Shaheen (*F. p. peregrinator*) has emerged. Its hunting technique has altered to suit the changed climatic and topographical conditions. The black Shaheen is quite similar in size to the red-naped Shaheen but differs immensely in its colour scheme. Every year upto the sixth moult there is a conspicuous change in the markings, and colouring in this bird. Age recognition after this, as in the case of the passage peregrines and the red-naped Shaheen, is extremely difficult.

Between the far western form *babylonicus*, and its eastern counterpart *peregrinator* there exists yet an intermediate phase of the Shaheen falcon. I suppose this falcon is perhaps the first step in the evolution of the black Shaheen from the red-naped form. It is not as dark as the black Shaheen nor does it appear to be as light coloured as its red-naped 'ancestor'. With the passage peregrines and the *babylonicus* and *peregrinator* groups of falcons, it shares the common character of changing colour and feather markings with every successive moult.

I have attempted to describe only those true peregrine falcons and some of their subspecies that it has been my good fortune to study, keep and train for the practice of falconry. All my knowledge is therefore empirical and based on first hand experience. However in such matters as taxonomy and migration of the true passage peregrines, and other obscure phenomena, my hypotheses may be taken for what they are worth. Till better proof to the contrary emerge, I believe my assertions and suppositions will stand a good a chance of acceptance by the cognoscenti.

NEW DESCRIPTIONS

A NEW SPECIES OF *LONICERA* L. (CAPRIFOLIACEAE) FROM NORTH WEST HIMALAYA[1]

M. P. Nayar and G. S. Giri[2]

(*With a text-figure*)

During revisionary studies on the genus *Lonicera* L. (Caprifoliaceae) specimens collected from Chamba, Himachal Pradesh (*Lace* 1316 & *Lace* 1715) were found to be different from the species so far described. After critical study it is seen that this taxon belongs to the subsection Alpigeneae Rehder (Rep. Miss. Bot. Gard. 14: 102. 1903) of the genus *Lonicera* L. This new species is described and illustrated.

Lonicera laceana sp. nov.

Affinis *L. heterophyllae* Decaisne, sed foliis oblongis vel elliptico-oblongis, haud lobatis, apice apiculatis vel mucronatis, basi subrotundatis vel subcordatis, glabris, margine integeris, coriaceis; corollis extus glabribus, lobis margine haud ciliatibus differt.

Typus: Kalatop forest, Chamba, North-western Himalaya, 7000 ft. (2128 m.) 15th April 1896, *J. H. Lace* 1316 (Holotype CAL).

Shrubs or small trees, branches more or less round, solid, glabrous, bark greyish, prominently black-dotted. Winter bud with only one pair of outer scales, scales ovate-oblong, 10.0-12.0 x 2.5-3.5 mm, boat shaped, apex acute, glabrous. Leaves opposite-decussate, exstipulate, oblong or elliptic-oblong (4.0-) 6.0-8.0 (-12.0) x (2.5-) 3.0-4.0 (-6.5) cm, base subrounded to subcordate, apex apiculate or mucronate, margin entire, 6-8 pairs of lateral nerves nearly obscure near the margin, reticulations usually prominent on the upper surface, glabrous on both surface, coriaceous, shiny; petioles 4.0-7.0 mm long, glabrous, canaliculate. Inflorescence axillary, 2-flowered, peduncle 2.5-5.5 cm long, somewhat compressed, glabrous; bracts free, linear 5.0-7.0 mm long, as long as or slightly exceeding the ovary, margin distantly glandular, glabrous; bracteoles 2 pairs, free, subulate 0.5-1.0 mm long, inconspicuously glandular at the margin, glabrous. Calyx small, cup like with 5 small truncate limbs, persistent, margin entire or inconspicuously glandular, glabrous. Corolla 10.0-14.0 mm long, prominently gibbous near the base, glabrous without; bilabiate, lower lip oblong, 8.0-10.0 mm long, apex rounded, reflexed, upper lip 4-lobed, lobes unequal, ovate to oblong, apex rounded, margin not ciliated; tube shorter than the lower lip, densely pilose within. Stamens 5, attached near the throat of the corolla tube, filaments short, unequal in length, 3.5-5.0 mm long, stout, pilose at base, glabrous above, anthers large, nearly as long as the filaments, narrowly oblong, dorsifixed. Ovary free, cylindric, 3-locular, glabrous, 3.0-4.0 mm long; style deflexed, 10.0-12.0 mm long, densely pilose. Berries fleshy, usually one

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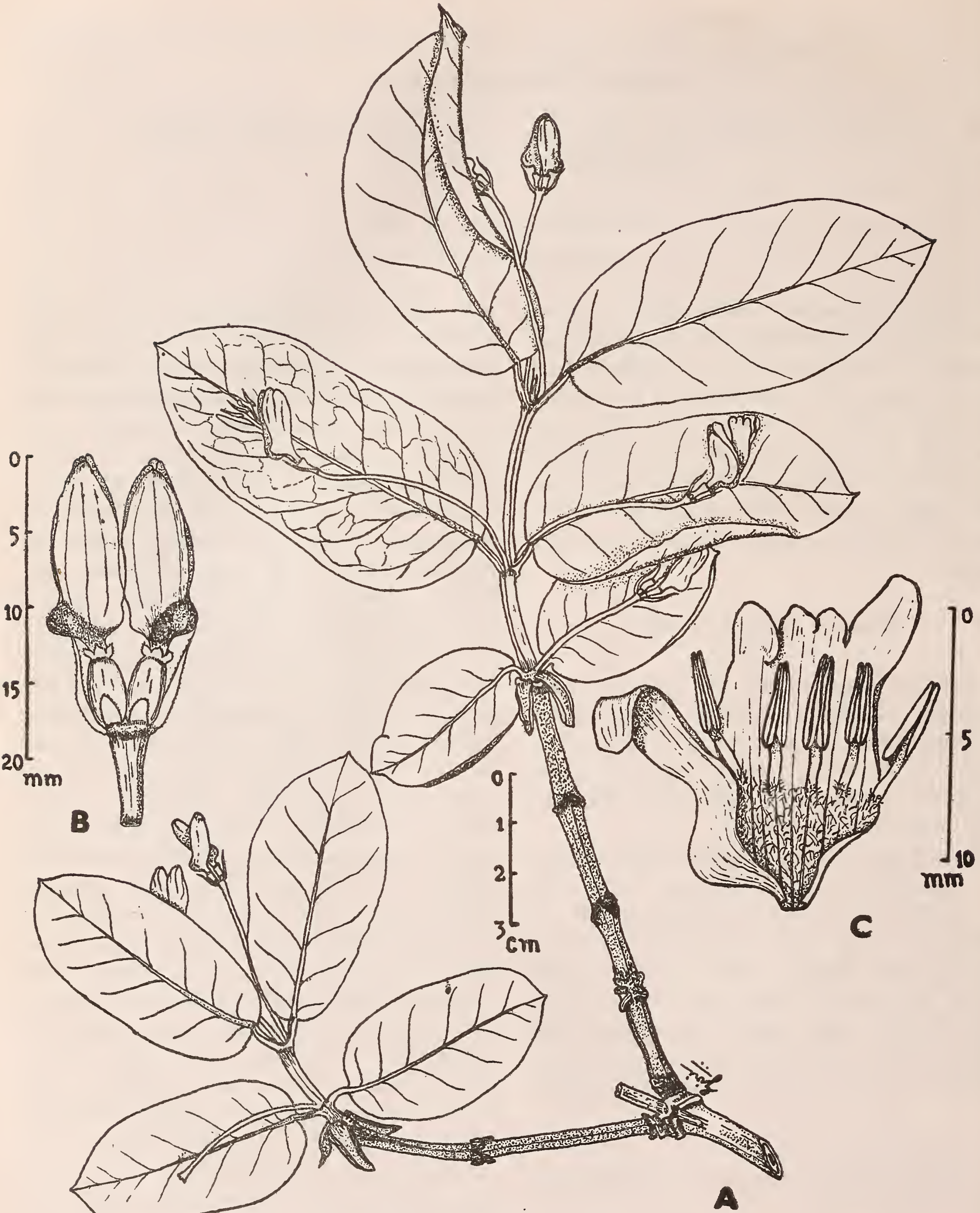
[1] Accepted July 1982.

[2] Botanical Survey of India, P. O. Botanic Garden, Howrah-711 103.


0
5
10
15
20
mm
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0
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2
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5
10
mm
C
A

Fig. 1. *Lonicera laceana* sp. nov.
A. Habit (natural size); B. Flowers with bracts and bracteoles; C. Corolla splited open, showing attachment of stamens and pilose nature within the tube.

TABLE

Lonicera heterophylla Decaisne	*Lonicera laceana* sp. nov.
1. Leaves elliptic or elliptic-lanceolate, lobed, apex acute or shortly acuminate, base cuneate.	1. Leaves oblong or elliptic-oblong, not lobed, apex apiculate or mucronate, base subrounded or subcordate.
2. Leaves membranous.	2. Leaves coriaceous.
3. Leaves pilose, at least on the nerves, margin undulate, distinctly ciliated.	3. Leaves glabrous, margin entire, not ciliated.
4. Corolla hispid hairy outside, corolla lobes ciliated at margin.	4. Corolla glabrous outside, corolla lobes not ciliated at margin.

smaller in the pair, oblong or ovoid, glabrous, ± 10 mm long, crowned with the persistent calyx.

The species is closely related to *Lonicera heterophylla* Dcne. but can be easily distinguished by the following characters (Table).

Distribution: Himachal Pradesh: Kalatop forest, Chamba, 2821 m. 15th April 1896 *J. H. Lace* 1316 (type); Kalatop forest, Chamba, 2432 m, June 1896, *J. H. Lace* 1715.

The species is named after its collector J. H. Lace who made extensive collections in the Chamba state of Himachal Pradesh.

TWO NEW SPECIES OF THE GENUS *STORTHECORIS* HORVATH (HETEROPTERA: PENTATOMIDAE)[1]

M. NAYYAR AZIM
AND
S. ADAM SHAFEE[2]

(*With ten text-figures*)

Storthecoris aligarhensis sp. nov. and *Storthecoris obtusiceps* sp. nov. are described and illustrated. Types deposited in Zoological Collections, Aligarh Muslim University, Aligarh, India.

Storthecoris aligarhensis sp. nov. (Figs. A-G)

FEMALE. (Fig. A)

Head: Dark brown with thick white hairs, distinctly wider than long (1.5:0.99 mm); juga dilated, as long as tylus; antenniferous tubercles projecting outwardly into acute spines; eyes dark brown, ocelli yellowish; rostrum extending upto mid coxae, segments I, II, III and IV, 0.85, 0.72, 0.52 and 0.33 mm in length respectively; anteroventral angles of bucculae rounded. Antennae (fig. B) dark brown, segments I, II, III, IV and V, 0.25, 0.25, 0.55, 0.4 and 0.69 mm in length respectively.

Thorax: Dark brown with white hairs, minutely and sparsely punctate except venter with irregular ridges; pronotum with anterior margin deeply concave, near each anterior angle with a long acute spine, extending beyond level of eyes, antero-lateral margins of pronotum straight and smooth, humeral angles subprominent and bidentate; maximum width

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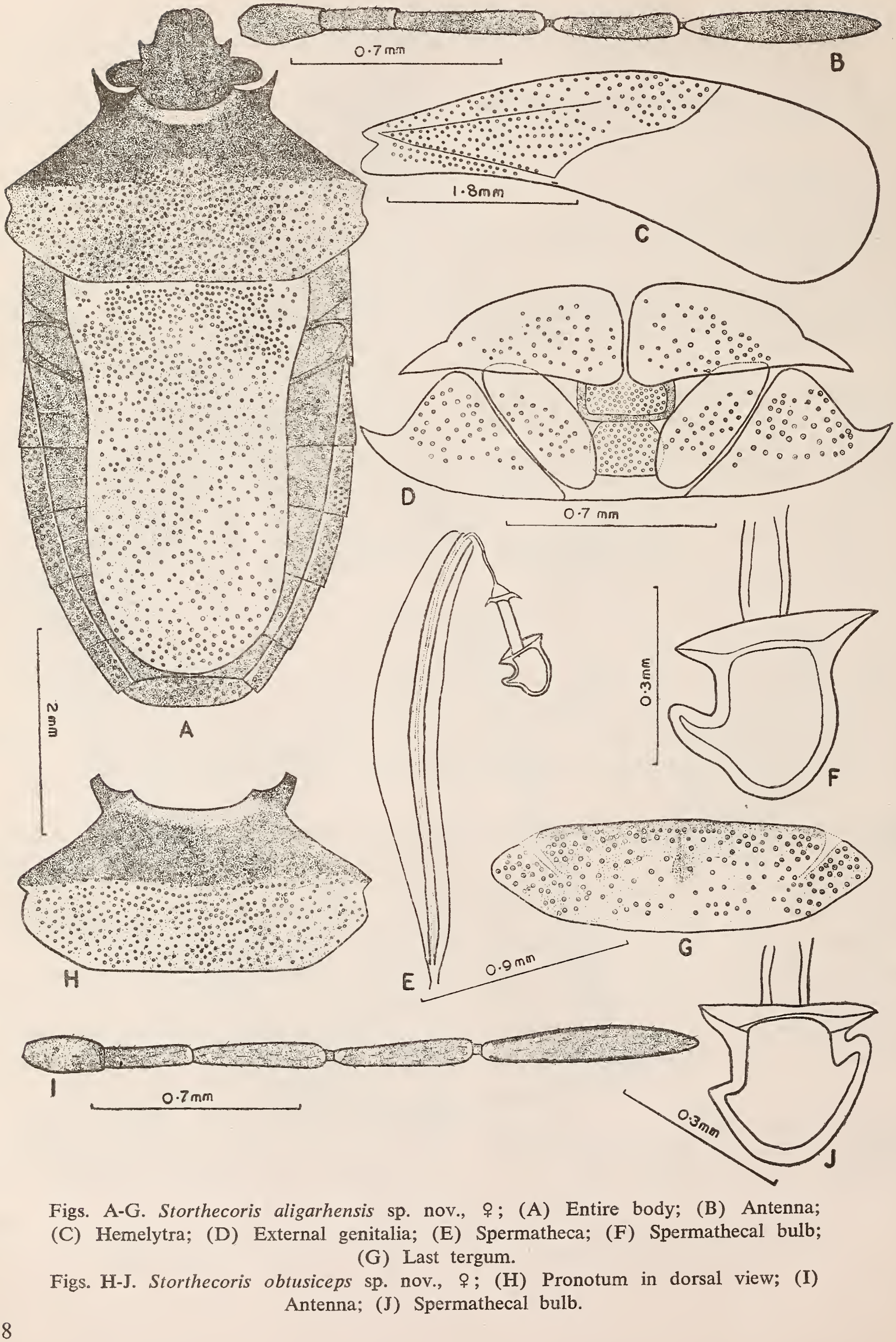
[1] Accepted October 1980.

[2] Section of Entomology, Department of Zoology, Aligarh Muslim University, Aligarh, India.


0·7 mm
B
1·8mm
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2 mm
E
0·9mm
0·3mm
F
G
H
I
0·7mm
0·3mm
J

Figs. A-G. *Storthecoris aligarhensis* sp. nov., ♀; (A) Entire body; (B) Antenna; (C) Hemelytra; (D) External genitalia; (E) Spermatheca; (F) Spermathecal bulb; (G) Last tergum.

Figs. H-J. *Storthecoris obtusiceps* sp. nov., ♀; (H) Pronotum in dorsal view; (I) Antenna; (J) Spermathecal bulb.

of pronotum about twice its median length (3.5:1.5 mm); scutellum well developed, twice as long as wide, reaching just before apex of abdomen; evaporatoria tuberculated. Hemelytra (fig. C) with corium sparsely punctate, more than one and a half times the length of membrane. Legs dark brown.

Abdomen: Dark brown except venter medially with a broad dark patch; distinctly longer than wide (3.9:3.3 mm); venter unsulcated and unarmed at base; last tergum (fig. G) in female with anterior and posterior margins slightly convex; external plates of female genitalia (fig. D) with 1st gonocoxae and 8th paratergites triangular, 9th paratergites oblong, much longer than wide; spermathecal bulb (fig. F) with a single protuberance.

Body length: 6.6 mm.

Holotype: ♀, INDIA, Uttar Pradesh, Aligarh, University Campus, on grass, 18.3.1979 (*M. Nayyar Azim*).

Paratypes: 2 ♀ (Same data as for holotype).

Storthecoris obtusiceps sp. nov. (Figs. H-J)

FEMALE

Resembles *S. aligarhensis* sp. nov. except in the following characters:

Antennae (fig. I) with third segment slightly shorter than fourth (0.48:0.51 mm); pronotum (fig. H) with anterior margin slightly concave, near each anterior angle with small spine truncated apically, not extending beyond the level of eyes; spermathecal bulb (fig. J) with two protuberances.

Body length: 6.5 mm.

Holotype: ♀, INDIA, Uttar Pradesh, Aligarh, University Agricultural farm, 10.8.1979 (*M. Nayyar Azim*).

Paratypes: 2 ♀ (Same data as for holotype).

ACKNOWLEDGEMENTS

We are deeply indebted to Prof. S. Mashhood Alam, Head, Department of Zoology, Aligarh Muslim University, Aligarh for providing research facilities. Thanks are also due to Prof. Nawab H. Khan for encouragement. One of us (M.N.A.) is thankful to U.G.C. New Delhi for financial assistance during the tenure of this work.

A NEW SPECIES OF THE GENUS *SYNIDOTEA* HARGER FROM WALTAIR COAST, INDIA (CRUSTACEA: ISOPODA: VALVIFERA)[1]

C. Jalaja Kumari and K. Shyamasundari[2]

(*With twelve text-figures*)

A new species of the genus *Synidotea* Harger, belonging to family Idoteidae is described. *Synidotea hanumantharaoi* sp. nov. is compared with *S. harfordi* Benedict, 1897, *S. variegata* Pillai, 1954, *S. worliensis* Joshi & Bal, 1959 and *S. fluviatilis* Pillai, 1963. Three male specimens were collected from the algal mass along the rocky intertidal region of Gangavaram, Waltair.

The isopods of the genus *Synidotea* are little known in India. Collinge (1917), Chilton (1924), Pillai (1954) and Joshi & Bal (1959)

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[1] Accepted July 1982.

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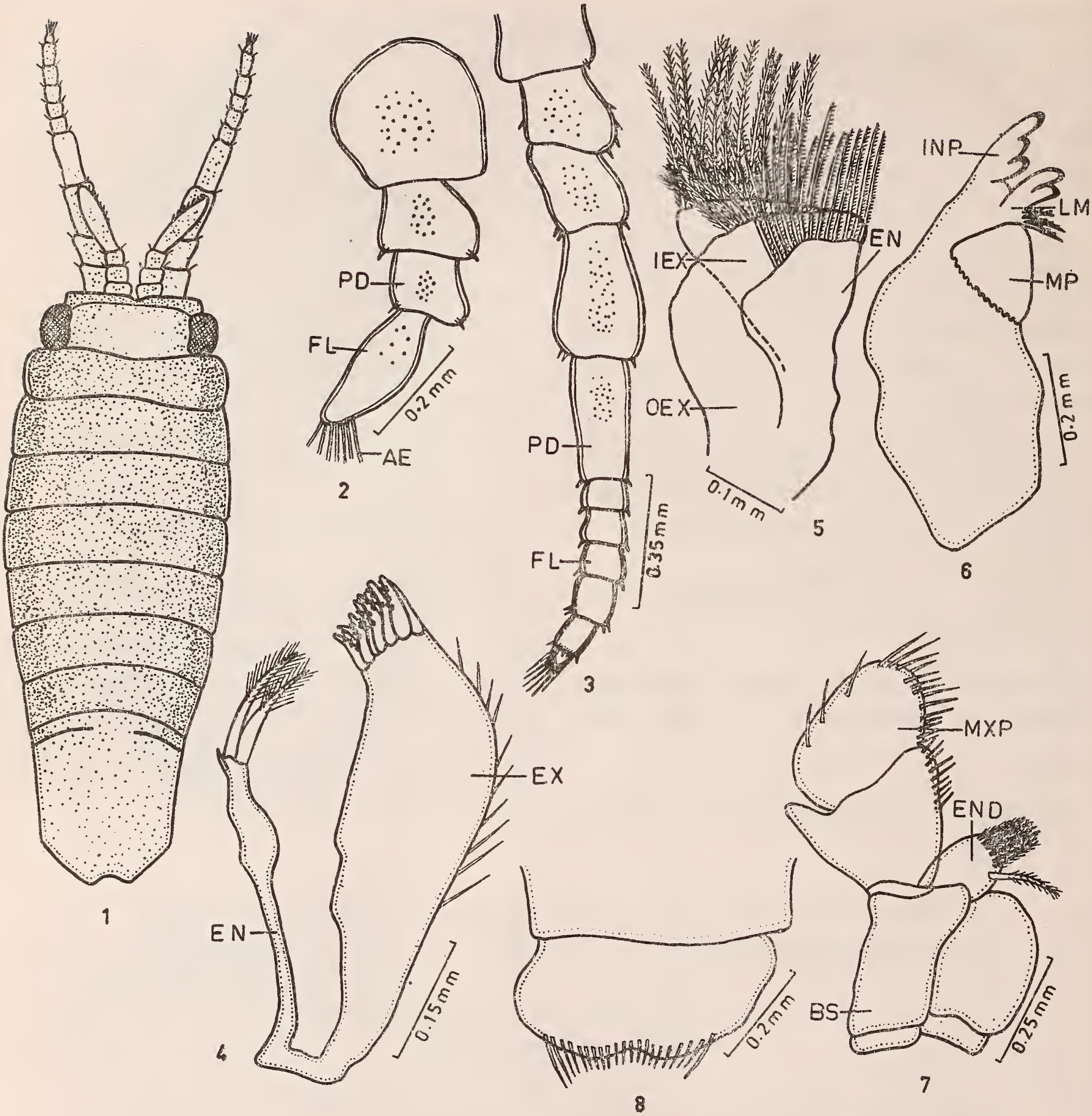
1
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FL
0.2 mm
AE
2
PD
FL
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MP
0.2 mm
6
EN
EX
0.15 mm
4
0.2 mm
8
MXP
END
BS
0.25 mm
7

Fig. 1. *Synidotea hanumantharaoi* sp. nov.; Fig. 2. Antennule; Fig. 3. Antenna; Fig. 4. Maxillule; Fig. 5. Maxilla; Fig. 6. Mandible; Fig. 7. Maxilliped; Fig. 8. Epignath.

Abbreviations:

AE — Aesthetascs; BS — Basis; EN — Endopod; END — Endite; EX — Exopod; FL — Flagellum; IEX — Inner lobe of exopod; INP — Incisor process; LM — Lacinia mobilis; MP — Molar process; MXP — Maxillipedal palp; OEX — Outer lobe of exopod; PD — Peduncle.

reported *Synidotea variegata* from Gulf of Mannar, Chilka Lake, Kerala and Bombay coasts respectively. Pillai (1954) described *Synidotea fluviatilis* from Quilon and Cochin. Joshi & Bal (1959) reported *Synidotea worliensis* from Bombay. This is the fourth species of this genus from India.

Synidotea hanumantharaoi sp. nov. (Figs. 1-12)

Male: Length 10 mm; Breadth 2 mm.

Colour: Dark greenish brown coloured body with little yellow tinge on the pleon region.

Body elongate-oval, nearly three times longer than wide, moderately flattened, dorsal surface smooth, lacking tubercles or rugae. Cephalon thrice as wide as long; frontal margin transverse, with a small median emargination or notch. Mid-dorsal portion of cephalon semi-circular. Eyes very large, oval and situated at extreme lateral edges of cephalon.

Antennule small, with three peduncular articles. Peduncular article 1 stout, with round base. Articles 2, 3 short and sub-equal. Antennular flagellum uniarticulate, stout, elongate-oblong, apically bears seven aesthetascs. Antennule extends to fourth peduncular article of antenna.

Antenna with 5 peduncular articles; article 1 short, articles 2, 3 subequal, article 4 stout, article 5 long and slender. Antennal flagellum 6-articulate, all articles bear simple setae. Terminal flagellar article possesses a bunch of setae.

Maxillule with 8 denticulate, stout, curved spines on exopod; 2 long, plumose setae and a small setule on endopod. Maxilla tri-lobate, endopod heavily setose, with 13 comb setae; inner lobe of exopod with 3 plumose setae and 8 comb setae; outer lobe of exopod with 11 plumose setae. Mandible with 3-cuspate incisor process; robust and serrated molar process; lacinia mobilis of 2 cusps and three spines. Maxillipedal palp of 3 articles; distal 2 articles with simple setae; endite with 1 coupling hook and 6 plumose setae along terminal margin. Epignath as wide as long projecting over the mandibles, posterior margin with median concavity, covered with setae.

Pereon roughly 2-2½ times longer than pleon; pereonite 1 dumbell shaped, with rounded lateral margins; border of pereonites 2-7 truncate. Pereonite 7 narrowest and shortest; pereonites 2-5 subequal; pereonites 1 and 6 subequal. Mid-dorsal line of pereonites 1-4 possess crescentic arcuate depressions. Coxae of pereonites 1-7 not formed on dorsal side.

Pereopods 1-7 gradually increase in length posteriorly, ambulatory. Pereopod 1 stout, with comb setae on inner surface of flat carpus, a strong hook like dactylus and heavy setation on ventral margin. Pereopods 2-7 subsimilar without comb setae, with weak setation on ventral margin.

Pleon composed of a single segment, with a pair of partial antero-lateral setules. Pleotelson about one third length of pereon, postero-lateral margins angular. Apex of pleotelson medially concave. Uropod uniramus, distally truncate, medial margins covered by setae, inner distal angle of peduncle with three, large, plumose setae. Pleopods 1-5 elongate oval and distally rounded. Endopod of pleopods 1-5 with naked margins and exopod with plumose setae on outer margin. Appendix masculina of pleopod 2 arises from basis, extends beyond tip of rami and terminally obtuse.

Material studied:

Three male specimens were collected from algal mass along the rocky intertidal region of Gangavaram, Waltair. Holotype male 1 and paratypes male 2 are lodged in the Department of Zoology, Andhra University, Waltair. They will be deposited in the collections of the Zoological Survey of India, Calcutta.

DISCUSSION

The present species resembles *Synidotea variegata* Pillai, 1954 in body form, arcuate depressions on pereonites, structure of maxillule, maxilliped and uropods, but differs in possessing short, stout antennule with 7 aesthetascs; short, stout antennae with 6 flagellar articles and truncate distal margin of uropod. It also resembles *Synidotea harfordi* Benedict,

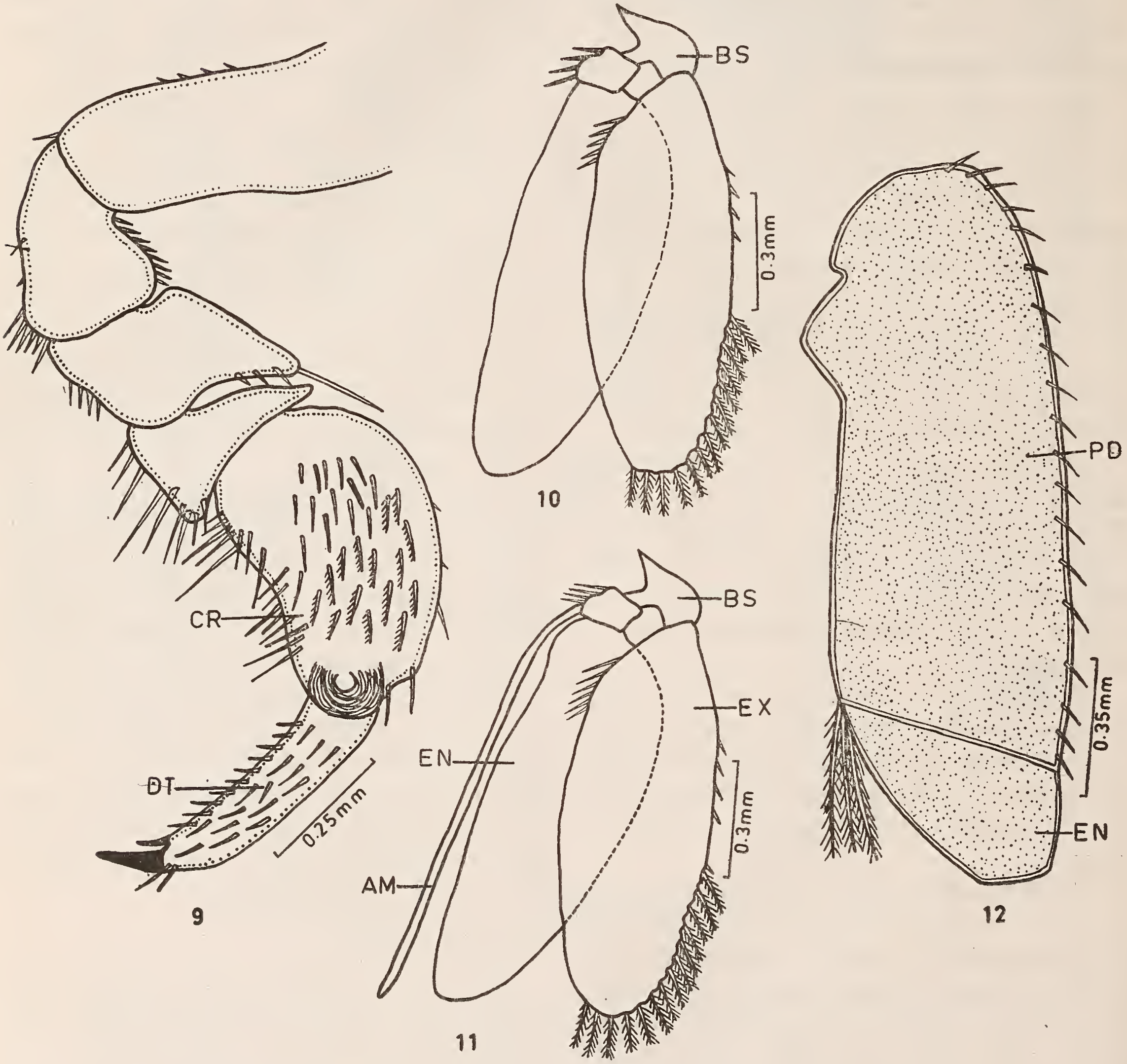

Fig. 9. Pereopod 1; Fig. 10. Pleopod 1; Fig. 11. Pleopod 2; Fig. 12. Uropod.
Abbreviations:
AM — Aesthetascs; BS — Basis; CR — Carpus; DT — Ductylus; EN — Endopod;
EX — Exopod; PD — Peduncle.

1897 in general shape. In *S. hanumantharaoi* the flagellum of antenna is composed of 6 articles; whereas in *S. harfordi* antennular flagellum consists of 31 articles. The present form shows some resemblances to *S. fluviatilis* Pillai, 1963 in the structure of maxillule, maxilla and distally truncated uropod, but can be easily separated by its differently shaped antennule, antenna and telson.

The present species also resembles *S. worliensis* Joshi & Bal, 1959 in the shape of maxilla, maxilliped and presence of arcuate depressions on pereon, but differs from it in the structure of antennular flagellum, uropods and telson, and thereby differs from all other species, especially in the structure of antennule, antenna, maxillule, maxilla and shape and size of the cephalon, pereon and pleon.

The species is named in honour of Prof. K. Hanumantha Rao, Department of Zoology, Andhra University, Waltair, India.

ACKNOWLEDGEMENTS

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DESCRIPTIONS OF TWO NEW SPECIES OF *TETRASTICHUS* HALIDAY (HYMENOPTERA: EULOPHIDAE) FROM INDIA[1]

S. ADAM SHAFEE, ANIS FATMA[2]
AND PREM KISHORE[3]

(*With five text-figures*)

Tetrastichus agarwali sp. nov. and *Tetrastichus delhiensis* sp. nov., parasites of *Atherigona soccata* (Rondani) are described and illustrated. The new species are compared with their closely allied species. Types are deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Tetrastichus agarwali sp. nov.
(Figs. 1-3)

FEMALE

Head dark except region below antennal in-

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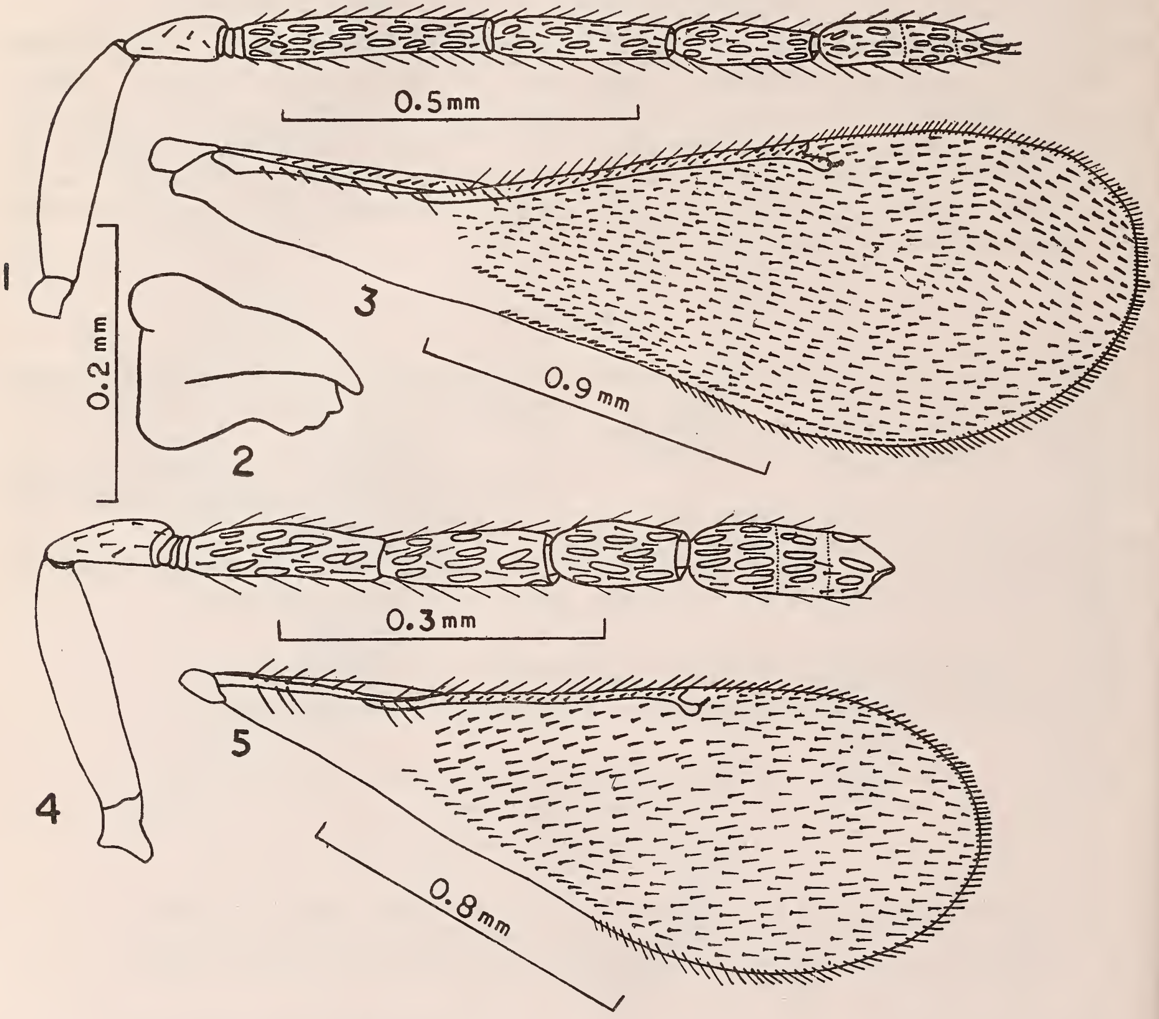
[1] Accepted May 1982.

[2] Department of Zoology, Aligarh Muslim University, Aligarh, India.

[3] Division of Entomology, Indian Agricultural Research Institute, New Delhi, India.

sertion, orbital margins, and malar space yellow; frontovertex about twice as wide as long; ocelli red, arranged in obtuse triangle, basal ocellus separated by two times its diameter from orbital margin and its own diameter from anterior occellus; antennae inserted above lower level of eyes; inter antennal space about one-fourth the width of frons at median ocellus; malar space as long as eye width, malar sutures distinct; maxillary and labial palpi each 1-segmented; mandibles as shown in figure 2. Antennae (fig. 1) dark brown



Figs. 1-3 *Tetrastichus agarwali* sp. nov., ♀:
(1) Antenna; (2) Mandible; (3) Fore wing.
Figs. 4, 5. *Tetrastichus delhiensis* sp. nov., ♀:
(4) Antenna; (5) Fore wing.

except ventral margin of scape yellow; scape four times as long as wide; pedicel two times as long as wide, less than half the length of first funicle segment; three ring segments distinct; funicle segments 1-3 gradually decreasing in length distad, first segment longest, six times as long as wide, third, three and a half times as long as wide; club, four times as long as wide, shorter than first and subequal to second funicle segment; funicle and club segments each with numerous sensoria.

Thorax dark with metallic bluish reflections; pronotum slightly shorter than scutum; scutum with 7 setae arranged in two rows near each parapsidal furrow; scutellum about as long as scutum, with two submedian grooves and two pairs of setae; propodeum with longitudinal carina medially. Fore wings hyaline, about three times as long as wide; costal cell slightly shorter than marginal vein and with 10 small setae; submarginal and marginal veins with 7 and 20 setae respectively, postmarginal vein rudimentary; stigmal vein short; marginal fringe short, spaced by a distance equal to one-fourth their length. Hind wings hyaline; marginal fringe longer than wing width. Legs yellow except hind coxae and all pretarsi dark brown.

Abdomen dark with metallic reflections, as long as thorax; ovipositor hidden, arising from basal one-third of abdominal venter. *Body length*: 3.06 mm.

Comments: The new species is closely related to *T. tritrichia* Saraswat, 1975 from which it can be separated by its having funicle segment first as long as scape, second as long as club; fore wings long and narrow with short stigmal vein.

Holotype ♀, Paratype 1 ♀, INDIA: Delhi, I A R I farm, ex *Atherigona soccata* (Rondani), on *Sorghum bicolor* (Linn.), 20.7.1978 (Prem Kishore).

This species is named after Dr. R. A. Agarwal, Head, Division of Entomology, I A R I, New Delhi, in recognition of his contributions to Applied Entomology.

Tetrastichus delhiensis sp. nov.
(Figs. 4, 5)

FEMALE

Resembles *T. agarwali* sp. nov. except in the following characters:

Head with ocelli white, basal ocellus separated by three times its diameter from orbital margin; malar space slightly shorter than eye width. Antennae (fig. 4) with scape slightly more than four times as long as wide; pedicel two and a half times as long as wide, more than half the length of first funicle segment; funicle segment first three and a half times, second three times, and third two times as long as wide; club three times as long as wide, as long as first and longer than second funicle segment.

Thorax with mesoscutum bearing four small setae near each parapsidal furrow. Fore wings less than three times as long as wide; submarginal and marginal veins with 7 and 16 setae respectively.

Abdomen slightly longer than thorax; ovipositor slightly exserted, arising from base of the abdominal venter.

Body length: 2.27 mm.

Comments: This species is closely related to *T. travancorensis* Saraswat, 1975 but is distinguished by its having the first funicle segment three and a half times as long as wide, as long as club; fore wings with short stigmal vein.

Holotype ♀, Paratype 1 ♀, INDIA: Delhi, I A R I farm, ex *Atherigona soccata* (Rondani), on *Sorghum bicolor* (Linn.), 20.7.1978 (Prem Kishore).

ACKNOWLEDGEMENT

We are deeply indebted to Prof. Nawab H. Khan, Head, Department of Zoology, for providing research facilities.

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ARUNDINELLA CANNANORICA: A NEW SPECIES OF POACEAE FROM KERALA, INDIA[1]

V. J. NAIR, P. V. SREEKUMAR AND N. C. NAIR[2]

(*With eleven text-figures*)

Arundinella cannanorica sp. nov.

Ab *Arundinella laxiflora* Hook. f., nodis ramorum villosis; ramis panicularum ascendentibus; carinis paleae infernae glabris, lemmate supero lemmatis inferni 2/3 longo, crasso, coriaceo, muricato; apice rotundato, non dentato; callo flosculi superi dense barbato differt.

Differs from *Arundinella laxiflora* Hook. f. in: branches villous at nodes; panicle branches ascending; keels of lower palea glabrous; upper lemma 2/3 the length of lower lemma, thick, coriaceous, muricate, tip rounded, not toothed; callus of upper floret densely bearded.

Annuals. Culms 20-50 cm tall, erect, slender; nodes glabrous. Leaves 2-5 cm long and 2-5 mm broad, mostly basal, lanceolate, base rounded or shallowly cordate, glabrous or covered with sparse tubercle-based hairs, especially along the margins. Sheaths 1-8 cm, lower ones shorter and upper ones much longer than the internodes, striate, glabrous or ciliate along one margin. Ligule, a row of hairs. Panicles 10-40 cm long, lax, willowy; branches 1-12 cm long, ascending, alternate or rarely whorled, slender, filiform, angular, bearded at the nodes with long silky hairs, purple; rhachis flexuous, angular and scaberulous; pedicels 2-15 mm long, slender, angular, scaberulous. Spikelets 5-6 mm long, lanceolate, acuminate, turgid, pale-green or purple, glabrous. Lower glumes 3.5-4.5 x 1.0-1.5 mm, ovate-lanceolate, strongly 3-nerved, purple, glabrous. Upper glumes 5.0-5.5 x 1.25-1.50 mm, ovate-lanceolate, caudate or long-acuminate, strongly 5-nerved, greenish with purple tinge, glabrous. Lower floret male; lemma 2.75-3.00 x 1.0-1.5 mm, ovate-oblong, obtuse, faintly 5-nerved, lateral nerves very close, pale-green, membraneous and glabrous; palea 2.0-2.5 x 0.50-0.75 mm, elliptic-lanceolate, 2-keeled and auriculate at base, 2-nerved, hyaline, glabrous; stamens 3, anthers 1.0-1.5 mm long, filaments short. Upper floret bisexual; callus bearded, hairs 0.25-0.50 mm long; lemma 1.75-2.00 x 0.50-0.75 mm, ovate or elliptic, tip with a geniculate awn, dorsally covered with numerous wart-like outgrowths, chest-nut brown when fully matured, awn 8-10 mm long, geniculate, column *c.* 4 mm long, chest-nut brown; palea 1.25-1.50 x 0.4-0.5 mm, oblong, acute, 2-nerved, with a few wart like outgrowths on

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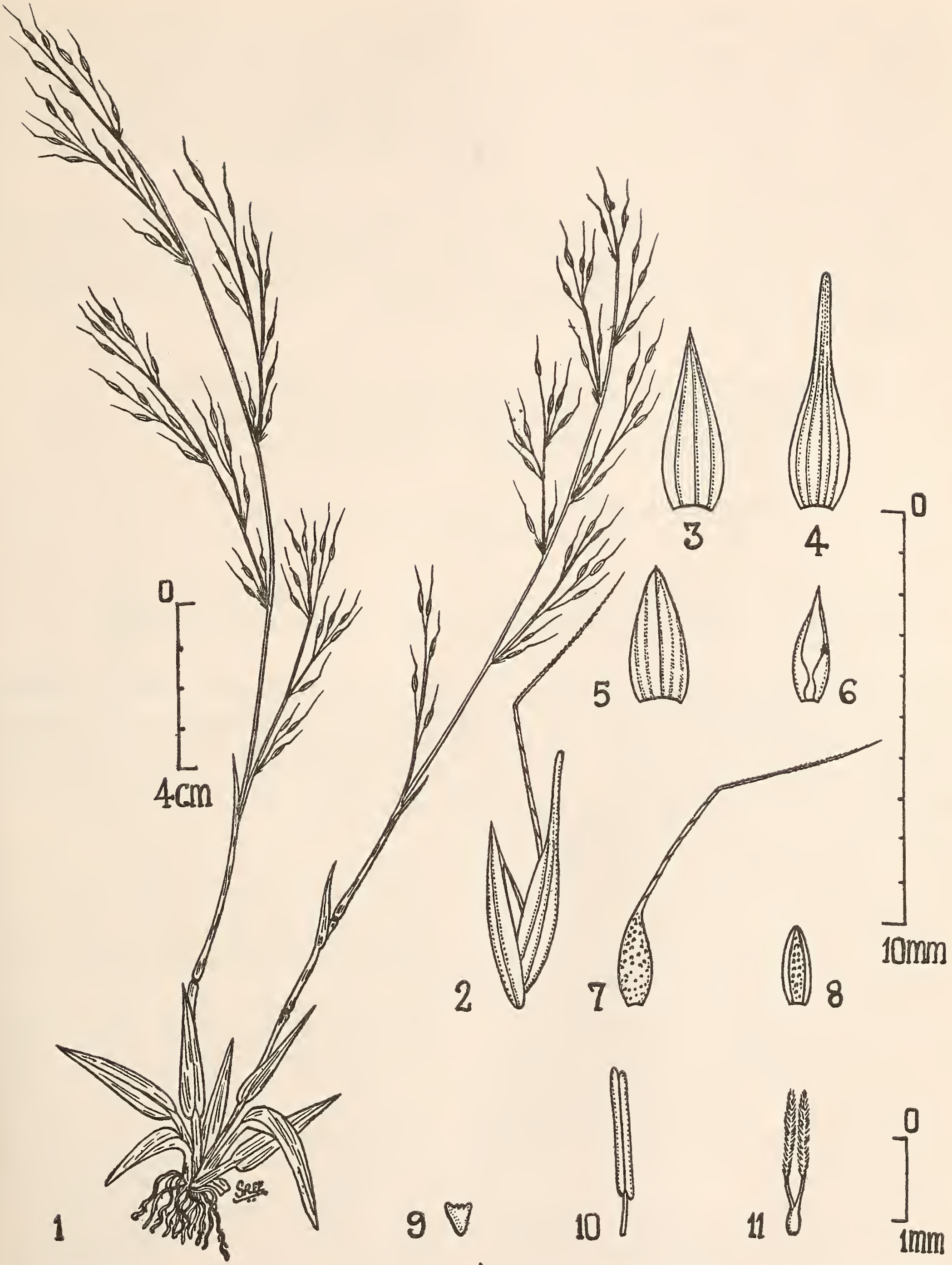
[1] Accepted July 1982.

[2] Botanical Survey of India, Coimbatore-641 003.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Figs. 1-11: *Arundinella cannanorica* sp. nov.
1. Plant; 2. Spikelet; 3. Lower glume; 4. Upper glume; 5. Lower lemma; 6. Palea; 7. Upper lemma; 8. Palea; 9. Lodicule; 10. Stamen; 11. Pistil.

the dorsal surface; lodicules 2, each *c.* 0.30 x 0.25 mm, obovate, denticulate at apex; stamens 3, anthers 1-2 mm long, violet, filaments short; ovary *c.* 0.25 x 0.15 mm, ovate, glabrous; styles *c.* 0.5 mm long, stigmas *c.* 1 mm long, pink, feathery.

Holotype: Cannanore District, Bela (in between Kumbla and Bedudka), ± 100 m, 23rd November 1981, *P. V. Sreekumar* 71822 (CAL). Isotypes in K, MH. Paratype: Cannanore District, Paramba (on way to Bendudka), 16th October 1981, *P. V. Sreekumar* 71718 (MH).

Frequent in dry rocky areas and open grasslands, and other very dry localities along with other grasses such as *Arundinella mesophylla* Nees, *Bhidea burnsiana* Bor and a few *Dimeria* spp.

We thank Dr. Thomas A. Cope, The Herbarium — Grasses, Royal Botanic Gardens, Kew, for kindly examining our specimens and for his opinion.

FIRST RECORD OF *PARACOCCUS* EZZAT & MCCONNELL (HOMOPTERA: PSEUDOCOCCIDAE) FROM INDIA WITH DESCRIPTION OF A NEW SPECIES[1]

Rajendra Kumar Avasthi and S. Adam Shafee[2]

(*With two text-figures*)

The genus *Paracoccus* Ezzat & McConnell [with *P. burnerae* (Brain) and *P. nellorensis* sp. nov.] is reported for the first time from India. The new species is described and illustrated.

Genus *Paracoccus* Ezzat & McConnell

Paracoccus Ezzat & McConnell, 1956: 37.

Type-species: *Pseudococcus burnerae* Brain, 1915 (by original designation).

Ezzat & McConnell (1956) erected the genus *Paracoccus* for seven species. They assigned to their newly proposed tribe Planococcini on the basis of the presence of sclerotized bar on the ventral surface of the anal lobes. Later, De Lotto (1964) recognized this character as of specific significance. Further, he redefined the genus *Paracoccus* as follows: "Occurrence of a series of seventeen pairs of marginal cerarii, all normally built up with two spines and devoid of auxiliary setae, except on the anal lobe cerarii in which one or more auxiliary setae are always present".

The genus *Paracoccus* [with *P. burnerae* (Brain) and *P. nellorensis* sp. nov.] is reported for the first time from India. It is represented by three species from Oriental region which are separated by the following key.

KEY TO ORIENTAL SPECIES OF *Paracoccus* EZZAT & MCCONNELL, BASED ON ADULT FEMALES

1. Antennae 7-8-segmented; body with 17 pairs of cerarii; oral-rim tubular ducts few on dorsum 2
— Antennae 9-segmented; body with 5-6 pairs of cerarii; oral-rim tubular ducts numerous on dorsum (Borchsenius, 1962: fig. 5) . . . . *P. pasaniae* Borchsenius
2. Antennae 8-segmented; circulus and sclerotized anal bar present; oral-rim tubular ducts 30-36 in number, single duct near most of the abdominal cerarii and some ducts scattered on median and submedian regions of the body (fig. 1; Ezzat & McConnell, 1956: fig. 11; De Lotto, 1967: fig. 6) . . . . *P. burnerae* (Brain)

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[1] Accepted August 1981.

[2] Section of Entomology, Department of Zoology, Aligarh Muslim University, Aligarh, India.

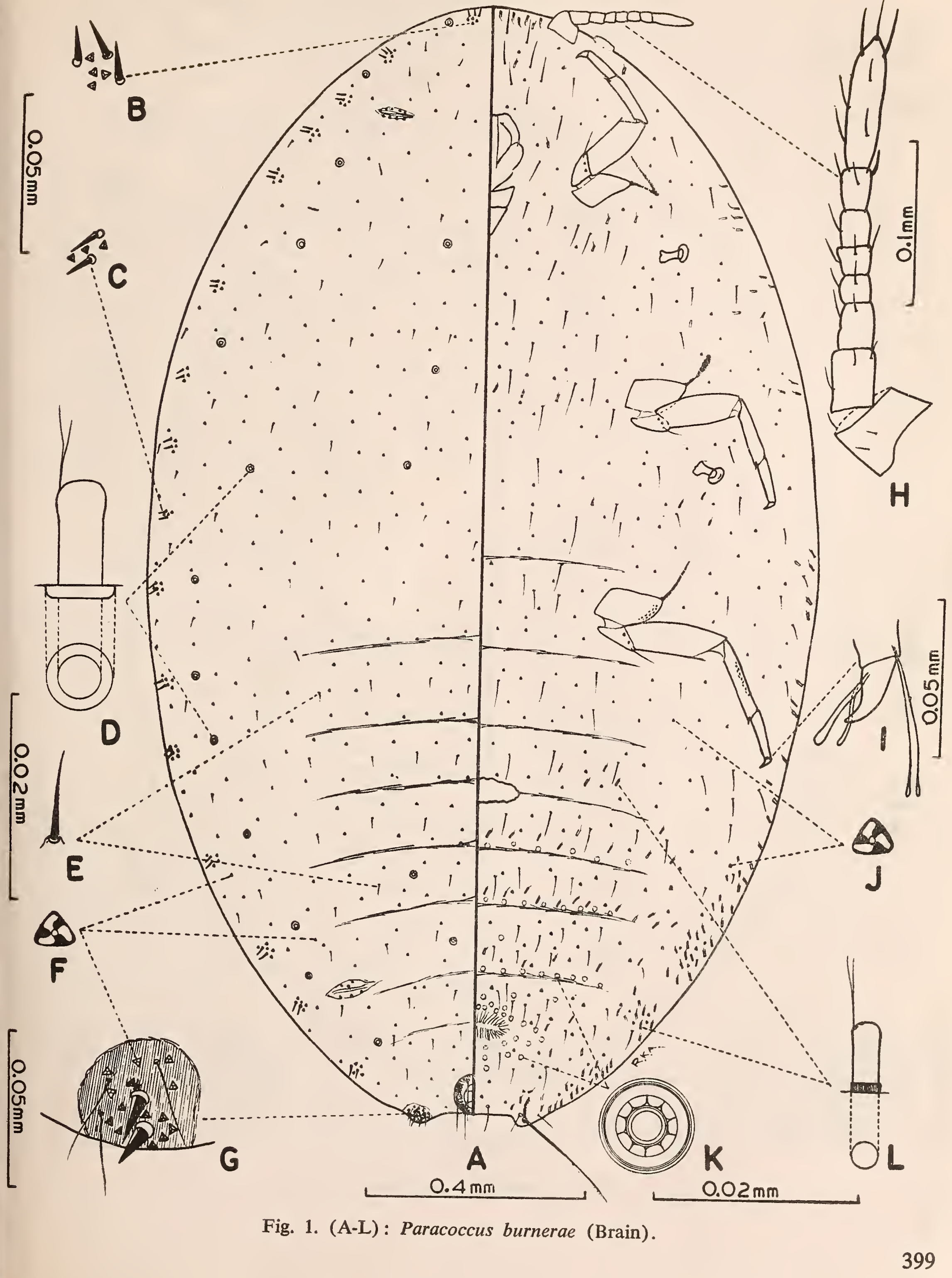
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Fig. 1. (A-L): *Paracoccus burnerae* (Brain).

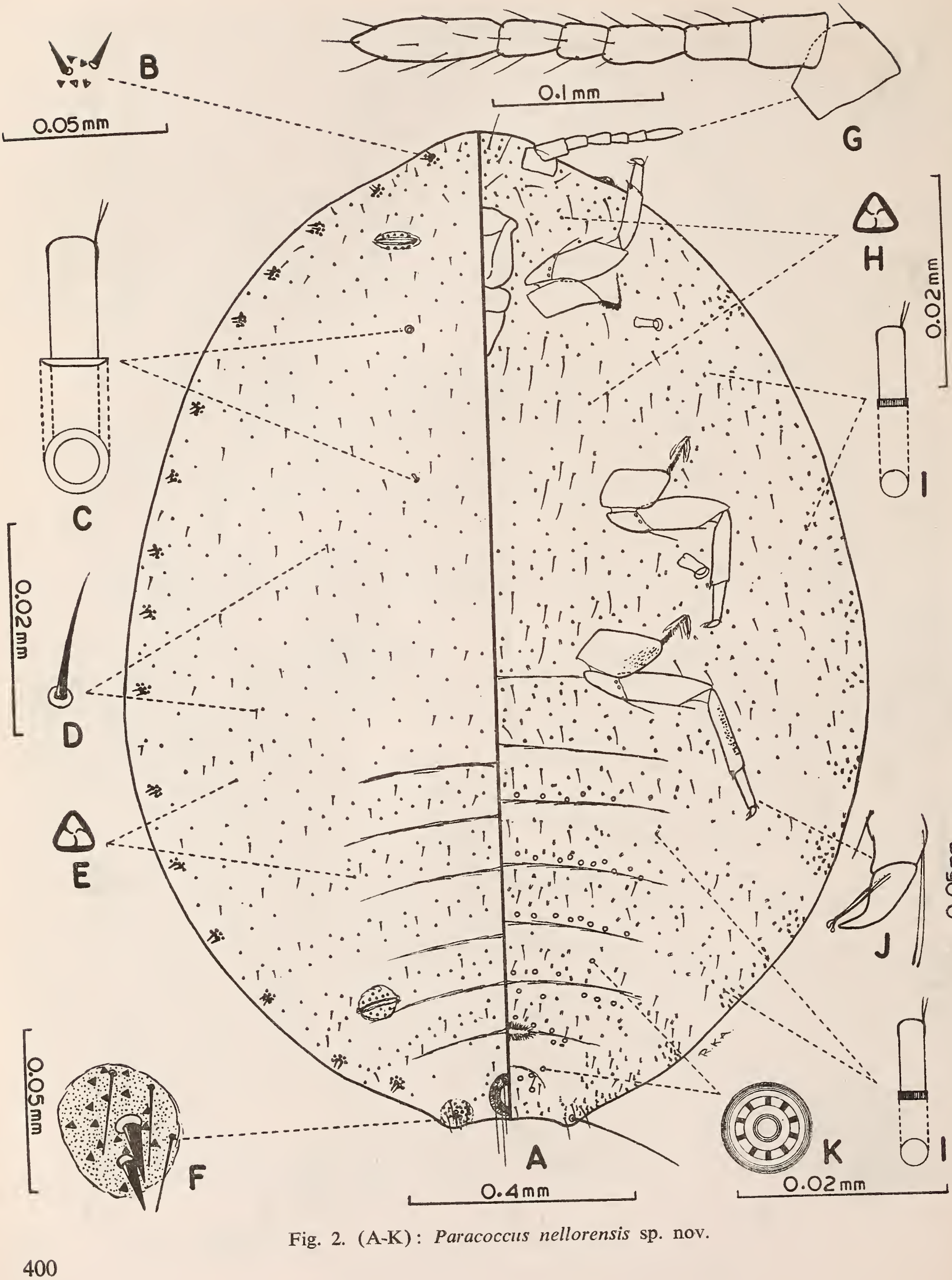
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Fig. 2. (A-K): *Paracoccus nellorensis* sp. nov.

— Antennae 7-segmented; circulus and sclerotized anal bar absent; oral-rim tubular ducts 3-5 in number, confined to mid thoracic region (fig. 2) ....*P. nellorensis* sp. nov.

Paracoccus burnerae (Brain)
(Fig. 1 A-L)

Pseudococcus burnerae Brain, 1915: 111; Hall, 1937: 126; De Lotto, 1958: 89. *Pseudococcus simulator* James, 1933: 434; Ezzat & McConnell, 1956: 106. *Paracoccus burnerae* (Brain), Ezzat & McConnell, 1956: 39; De Lotto, 1964: 359; 1967: 13.

Material examined: 6 ♀, INDIA: Uttar Pradesh, Aligarh, University Campus, on *Dalbergia sissoo,* i. xi. 1979 (*R. K. Avasthi*). Material deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Paracoccus nellorensis sp. nov.
(Fig. 2 A-K)

ADULT FEMALE (fig. 2A):

Mounted specimens broadly oval in shape, less than one and a half times longer than wide (1.72: 1.32 mm); anal lobes moderately developed. Dorsum with small and thin setae (fig. 2D). Trilocular pores (fig. 2E) numerous, evenly distributed on cephalic and thoracic regions, segmentally arranged on abdominal region. Oral-rim tubular ducts (fig. 2C) only 3-5 in number confined to mid thoracic region. Ostioles well developed with membranous inner edges of anterior and posterior lips, each with 4-8 trilocular pores and devoid of setae. Body with 17 pairs of cerarii; anal lobe cerarii (fig. 2F) with basal area slightly sclerotized, each with a pair of stout conical spines, 3 auxiliary setae and a group of about 15 trilocular pores; cerarii anterior to anal lobe each with a pair of small spines; 4-7 trilocular pores and devoid of auxiliary setae. Anal ring with 6 setae which are about one and a half times longer than the greatest diameter of ring.

Venter with numerous hair-like setae of variable lengths; anal lobe without sclerotized bar; anal lobe seta about twice the length of anal ring setae. Trilocular pores (fig. 2H) sparsely distributed. Multilocular pores (fig. 2K) arranged medially in transverse rows on abdominal segments IV to IX. Oral-collar tubular ducts (fig. 2I) small, arranged in groups on margins of thoracic and abdominal regions and sparsely distributed in submarginal and median areas of the body. Oral-rim tubular ducts absent. Eyes well developed. Antennae (fig. 2G) 7-segmented, 0.29 mm in length. Rostrum dimerous. Spiracles normal. Circulus absent. Legs well developed; hind coxae and tibia with translucent pores; claws (fig. 2J) simple with digitules slightly longer than claw and clubbed at apices; dimensions of fore, mid and hind legs: trochanter + femur (0.17:0.19: 0.21 mm), tibia (0.11:0.12:0.15 mm) and tarsus (0.05:0.06:0.07 mm) respectively.

Holotype ♀. INDIA: Nellore, Andhra Pradesh, on weed plant, 14.iv.1979 (*R. K. Avasthi*).

Paratypes. 4 ♀, same data as holotype.

Types deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

In the key to African species of *Paracoccus* proposed by De Lotto (1964), *P. nellorensis* sp. nov. seems close to *P. muraltiae* (Brain), but is distinguished by the presence of 7-segmented antennae, translucent pores on hind tibiae and oral-collar tubular ducts in groups on ventral margin of thoracic region.

ACKNOWLEDGEMENTS

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HEDYOTIS SILENT-VALLEYENSIS (RUBIACEAE) — A NEW SPECIES FROM SOUTH INDIA[1]

E. VAJRAVELU, N. C., RATHAKRISHNAN AND
P. BHARGAVAN[2]

(*With five text-figures*)

During the botanical exploration in the Silent Valley R.F., Palghat District, Kerala in 1966 we collected a *Hedyotis* sp. on the grassy slopes of Kunthipuzha dam-site. On scrutiny and in consultation with Central National Herbarium, Howrah and Royal Botanic Gardens, Kew, it is described as a new taxon.

Hedyotis silent-valleyensis sp. nov.

Affinis *H. purpurascens* Hook. f. tamen differt foliis elliptico-lanceolatis, veinsque distinctis; ramulis, pedunculis, pedicellis et calycibus pubescentibus.

Hedyotis silent-valleyensis sp. nov. is allied to *H. purpurascens* Hook. f. [= *Oldenlandia purpurascens* (Hook. f.) Kuntze] but differs in having elliptic-lanceolate leaves with distinct veins; pubescence all over the branchlets, peduncles, pedicels and calyx.

Woody shrubs 1-3 m high, branching profusely towards the end of branches. Leaves opposite, decussate, shortly petioled, 2-9 x 0.6-2.0 cm, elliptic-lanceolate, acute-acuminate; nerves 3-4 pairs, distinct, puberulous beneath; stipules 4-10 x 3-5 mm, ovate-triangular, pubescent, 5-12 toothed; Inflorescence pubescent, paniculate cymes, branching trichotomously, 7.5-18.0 cm long; middle flowers sessile, side flowers pedicellate, rachis slender. Calyx pin-

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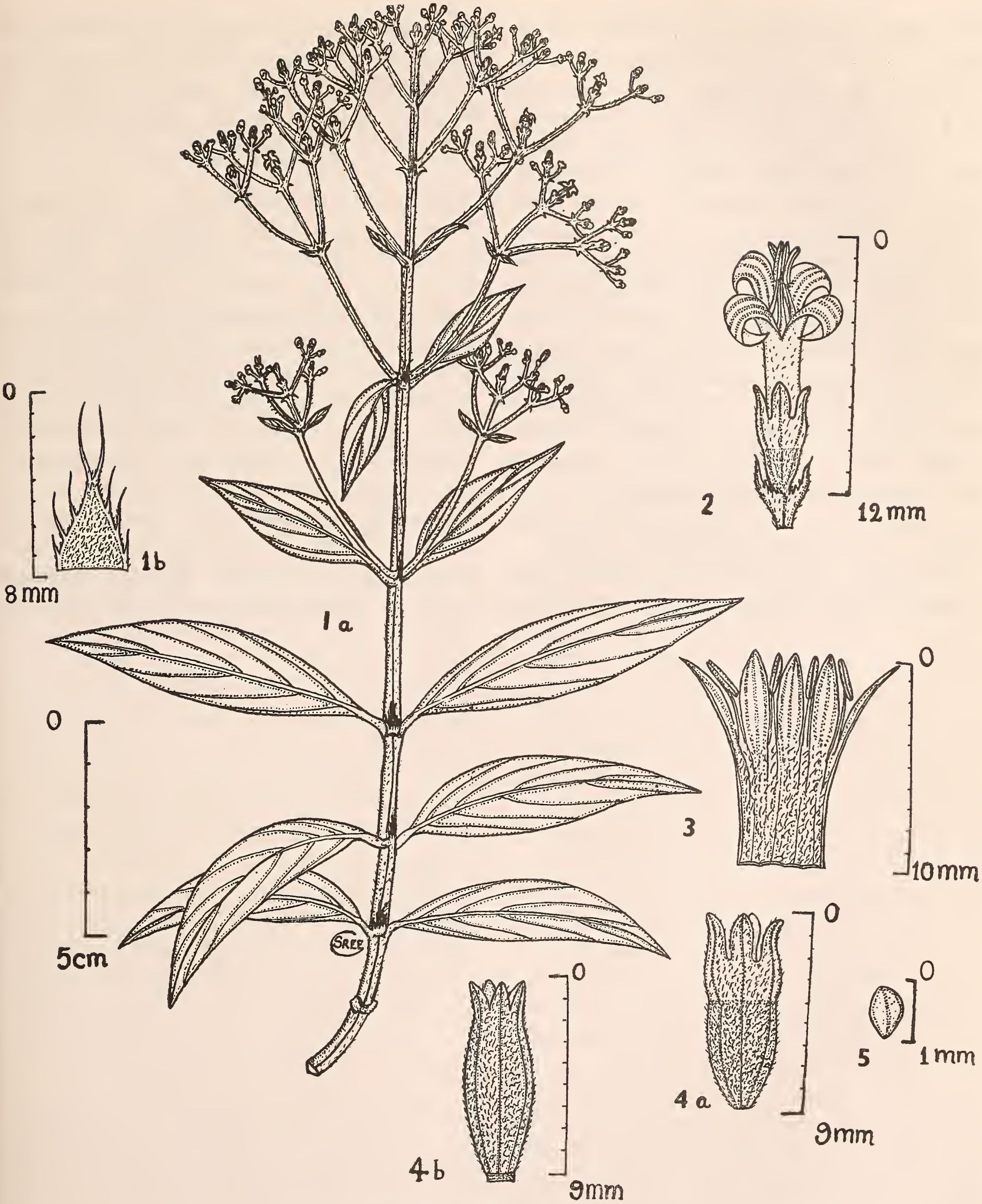
[2] Botanical Survey of India, Coimbatore-641 003.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Figs. 1-5. *Hedyotis silent-valleyensis* sp. nov.
1a. Flowering branch. 1b. Stipule. 2. Flower (Sessile). 3. Corolla split open showing stamens. 4a & 4b. Capsules immature & mature). 5. Seed.

kish, pubescent; tube 3.0 x 2.5 mm; lobes 4, rarely 5, 0.75-1.5 x 0.5-1.0 mm; corolla infundibuliform, bluish purple, throat sparsely hairy inside; tube 4-6 mm long, lobes 4, rarely 5, reflexed, 2.5-3.5 x 1.0-1.5 mm, oblong-lanceolate, puberulous without. Stamens 4, rarely 5, epipetalous, exserted; anthers blue, dorsifixed, dehiscing with two slits; filaments 2 mm long. Ovary 2-locular; ovules numerous. Style linear; stigmas 2, hairy. Capsules 5-9 x 2-3 mm, ellipsoid-obovoid, crowned by the calyx-limbs, dehiscing septicidally into 2 cocci. Seeds 1.0 x 0.5 mm, obscurely angled. (Fig. 1-5).

Holotype, *Vajravelu* 27674 (Kunthipuzha dam-site, Silent Valley R.F., Kerala, 27-5-1966) is deposited in CAL; isotypes, *Vajravelu* 27674 (three specimens) and paratypes *Vajravelu* 48857 (seven specimens) from the same locality on 6-11-1976 are deposited in MH.

The species is named after the type locality — Silent Valley, Palghat District, Kerala, in whose conservation naturalists, ecologists and environmentalists have focussed their attention. The distribution of this species is confined to the grassy slopes of the Kunthipuzha dam-site.

ACKNOWLEDGEMENTS

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MISCELLANEOUS NOTES

1. STATUS AND ECOLOGY OF WILD BUFFALO (*BUBALUS BUBALIS* LINN.) IN CHANDRAPUR DISTRICT OF MAHARASHTRA

INTRODUCTION

Dunbar Brander reported two small herds of Wild Buffalo in Allapalli division of South Chanda. He also reported a few herds in the Ahiri blocks of North Chanda. Since then, there has been no authentic report on the status of Wild Buffalo in Chandrapur District. In the last 75 years, most of the forest in North Chanda and Ahiri have disappeared, so also the natural habitat suitable for Wild Buffalo. Mr. Rego, Chief Wild Life Warden of Maharashtra in 1976 informed us that the only area where Wild Buffalo could still occur is the forest ranges of Tadgaon and Bhamragarh, of Allapalli division. These forest ranges adjoin Bastar district of M.P. Daniel and Grubh (1966), in their report on Indian Wild Buffalo, had estimated a strength of 200 to 250 Wild Buffaloes in West Bastar Division adjoining Allapalli division. H. K. Divekar (1976) estimated a strength of about 50 animals in the same area. In order to establish the present status of Wild Buffalo in Maharashtra resident or migratory between Maharashtra and Bastar, M.P. a survey was undertaken by us.

AREA SURVEYED

Chandrapur District borders Bastar district of M.P. the boundaries being Indravati river in the South and Kuvakodi hills in the west. In Allapalli division, several perennial rivers flow amidst mountainous terrain, the major ones being Indravati, Parlakota, Bandia, Pamalgotam. There are a tangle of hills in this division chiefly Lahir Bhamragarh hills, and Surajgarh hills, the hill ranges rise on an average to elevation of about 700 metres, the highest being 935 metres. The Bhamragarh hills overlook the confluence of the Indravati and two of its right bank tributaries, the Parlakot and Pamalgotam.

There are many small and big lakes in Allapalli division, the major ones being Mirkal lake near Madepalli, two more near Manne Rajaram and Echeli near Tadgaon, a minor irrigation bund near Mallampattu and a large tank near Pirimili.

Forests: Allapalli holds some of the best quality teak trees in Asia with heights ranging upto 125 feet. The quality of the timber of this forest are rated next to Burma teak. Besides teak, sisam (*Dalbergia sissoo*), Bija (*Pterocarpus marsupium*), Simul (*Gossypium arboreum & Gossypium herbaceum*) are also common. The Ballarpur Paper & Strawboard Mills is based on this forest wealth.

Due to ever increasing demand of timber and in particular bamboo for paper pulp, the quality of forest and density has been considerably eroded. Virgin forest tracts in the Kuvakodi hills on the eastern boundary have now been taken up for bamboo extraction (140 kms east from Allapalli) since the time of this survey. Thus beginning the destruction of the last virgin bamboo forest in Chandrapur district. The Allapalli division has the highest percentage of forest area approximately 92% of the total area. The list of the main flora of Bhamragarh range is given in table 2.

Method of Survey: In absence of any authentic record of occurrence of Wild Buffalo in any particular part of the survey area, it was decided to examine the entire Indravati river bank falling with in the perview of the survey area and also a major part of the tributaries, village tanks and water bunds. All forest areas where Wild Buffalo occurrence was reported by tribals and forest officials was also investigated. The Wild Buffalo occurring in a particular forest block, would come down to graze on the grass growing along the river banks, to drink and wallow and thereby leave sufficient evidence of possible pockets of occurrence and herd strength. The survey area was divided into 3 blocks. Each block was exhaustively surveyed. The survey party was divided into groups and each group was given an independent specified area. Each group was led by a competent field investigator. Each area was planned to be visited twice to avoid any ommission and also to record fresh indications or tracks of wild Buffaloes. The leader of each group was also required to report on birds, mammals and general floristic situation.

The survey was completed on foot. Assistance of tribal guides and local forest guards was sought for individual groups. The field notes included location, identification, sketch, of tracks, sightings, droppings, general description of the habitat, human interference, interviews with local people etc.

General Account of Survey: The survey was planned to be conducted sometime between December to May when the area becomes accessible. Block 1 was surveyed between 7th May to 12th May, 1978. The Block 2 Itapalli Surajgarh was surveyed between 28th December, 78 to 4th January, 79. Block 3 was surveyed between 9th to 13th May, 79. The area surveyed, investigator groups, observations are shown in table 1.

Habitat: The Allapalli forest division of Chandrapur district is one of the more heavily worked forests in Maharashtra. Several thousand hectares of forests have been clear felled and new teak plantations are coming up every year. Excepting pockets in Kuvakodi hills, there is no virgin forest left. One often sees clearings in the forest made by the gonds for purposes of their "Gata" cultivation. These are plots chosen near Adivasi villages. Many of them are left as waste lands. Over 100 commercial forest department heavy vehicles ply on the interior forest roads, right up to southern and eastern boundaries of the district for transporting bamboo, teak, charcoal and other forest produce like bedi leaves and lac. Adivasi Gond villages are set up all along the perennial river banks of Allapalli division and in Gatta range.

Other than the teak plantations, the forest has been affected by human influence so much so that natural forests are minimal. The area is heavily over grazed and trampled by domestic cattle and sheep. The effect of villages can be seen for atleast 1 km radius around each village and right upto Indravati river. Under these conditions, it is very difficult for the wild buffalo to inhabit the area.

All along the Indravati river, downstream from Bhamragarh upto the confluence of its right hand tributaries Bandia and Pirimili rivers approximating to 28 Kms., there are many heavy grass patches and thickets and water pools which are ideal wild buffalo habitat. However, many villages like Palli, Boria, Jarewada, Manne Rajaram etc. are situated. Also along the banks of the Indravati river huge charcoal ovens are permanently set up a few hundred yards from the river banks. It is unlikely therefore, that the wild buffaloes cross over and stray into forest coming under Tadgaon range of Allapalli division. The Indravati river on its Maharashtra side banks upstream from Bhamragarh to Kundanallah confluence has almost lost its natural habitat of grass patches and thickets and are heavily trampled by domestic cattle and over grazed. The river basins of Pamalgotam and Parlakota upstream the confluence of Indravati passes through some grass patches. Though the forest is almost plain, the habitat is devoid of virgin grass forage grounds. All the tributaries of Indravati river run dry in hot season and the habitat is unsuitable as there is hardly any undergrowth or water pools. The habitat in Gatta and Itapalli range have no perennial water source and neither suitable forage grounds ideal for wild buffalo. Elephant grass grows in patches upto 1.80-2.10 m and can be seen in Bhamragarh and Itapalli range. These are normally the grazing ground for the village cattle. The forest block around Mirkal lake, forest patches at Thalwada and interior of Lahiri and Kuvakodi hills and valleys are the potential habitats left over in the Allapalli division. Some indications of existance of wild life and virgin flora can be seen in the above forest patches.

Human Interference: Bhamragarh and Tadgaon forest ranges have several revenue villages. A large net work of fair weather roads connect these villages with main activity centres like Bhamragarh, Tadgaon, Itapalli, Allapalli etc. These villages are populated by tribals like Gond, Pradhan, Halba, Kawar, Maria & Murias etc. Maria & Muria tribes are the ones who account for the maximum interference and hunting of wild life, whereas Halbas, Pradhans and Gonds chiefly account for destruction of the habitat and domestic cattle rearing.

For the bulk of the Adivasi population, cultivation is merely a secondary means of winning a livelihood and serves only to supplement the food supply from forest produce. For the Muria tribals, hunting is the main livelihood in the hot months from February to May. No animal, bird, or reptile is spared in these communal hunts.

Each and every event from ploughing to reaping, birth of a child or death in a village, marriage, and other communal festivities only begin with hunting and drinking liquor. One can see the effect when he passes from one range of forest to another range without seeing a single indication of existance of wild life for several kilometres.

Often, the tribals have to be on the hunt for several days or intrude into Bastar district to procure a single animal to begin the festive event.

Though nothing was reported or seen by the survey party during the survey, illegal poaching by traders, contractors and others cannot be ruled out. During interviews with villagers, and others, it was reported that almost all the villagers own one or two fire arms like muzzle loading guns. These are systematically used in the hunting grounds by these tribals. It was also reported that illegal ammunition traders and suppliers have regular contact with the tribals.

All living animals and birds including sparrows, rats are eaten by the tribals. Similarly, many varieties of wild fruits, bamboo shoots, roots, green vegetable matter also form the staple food of the tribals. Cattle is the main pest of the forest. With non-availability of veterinary knowledge or facility, there is no prevention or cure for the cattle which may contract and spread disease to whatever remains of the wild life.

Interviews: Taperecorded and oral interviews with various forest officers, Shikaris, forest guards, plantation managers, tribals, Interviews with J. K. Sangode, Deputy Engineer, Irrigations, Madhav Naik, R.F.O., Gagga Papaya, Shikari guide and Gurmukh Singh, Asst. Forest Manager, Ballarpur paper Mills gave information about local flora and fauna. Mr. Gagga Papaya informed that the last Wild Buffalo hunt party was arranged for Mr. Nanavati, an I.C.S. Officer about 20 years ago. He was uncertain of the facts and the year of the hunt. However, he stated that one wild buffalo was killed during the hunt and he also mentioned that the party had to cross over to Bastar district to kill the Buffalo.

Katugagru Pongati tribal of Golaguda (Age 30) stated that there are no wild buffaloes between Bhamragarh and Nilkonda. He has neither seen one nor their tracks. He reported that cattle lifting by tigers was very common. All the survey parties of Block 3 reported fresh tiger pug marks. Spotted deer were commonly seen near plantations. One of us (HKD) saw on all his four visits to the area, spotted deer in herds of 3 to 8 on the road from Allapalli to Itapalli and also from Allapalli to Mirkal. Sloth bear are very common in the hilly terrain. Many accidents are reported in encounters with bears. Mr. Sharad Kulkarni stated that every year, 2 to 3 cases of bear attack victims are brought to him for treatment. Tribals reported that they are attacked by bears while hunting for deer, monkeys etc. Leopards are sighted often on forest roads around Bhamragarh. Gaur are reported to have been sighted near Mirkal lake and Lahiri hills. Other than these, monkey, flying squirrels, sambar, blue bull, four horned antilope, porcupine, jackal, jungle cat are reported seen by many tribals. Dr. Prakash Amte at Hemelkasa, 2 Km from Bhamragarh maintains a private zoo to house the wounded, orphan or trapped wild animals. The collection is an evidence of the occurrence of wild life in the area.

DISCUSSION

Dunbar Brander mentioned 2 small herds of cows and a few solitary bulls in the Allapalli and Gatta ranges of South Chanda District in 1904. He also mentioned that south eastern portion of Allapalli and in Ahiri state, they were somewhat more common and observed it was unlikely that these herds could have increased since 1904. He predicted their disappearance from these areas unless they are migrating from the neighbouring forest of Bastar. Dunbar Brander writing on the same topic mentioned their earlier range from records in Yewatmal and Bhandara districts and also in north Chanda, and wrote they had disappeared from the above tracks. Other sportsmen and naturalists have not ventured to assess the status or occurrence in Allapalli division in South Chanda. Wanting authentic records, the status of wild buffalo in Chandrapur District of Maharashtra has been a subject of guess work. Chandrapur Dist. Gazetteer is given as wild buffalo, "Jungli Bhainse" (*Bubalus bubalis*) used to be noticed occassionally in small herds around Mirkal tank near Allapalli, where they migrated in small numbers from the adjoining forest of Madhya Pradesh during spells of hot weather. The above report in gazetteer coincides with the writings of Dunbar Brander. It can be well argued that the statement in the Dist. Gazetteer is derived from Dunbar Brander's report. Allapalli forest division of South Chanda District is known for its valuable timber and bamboo. The habitat has lost all its natural features possibly after the starting of

Ballarpur Paper Mills and Teak Plantations by forest department. Our survey is the first attempted status and ecology survey of wild buffalo in Allapalli division of South Chanda District. This area was the only possible habitat left in Maharashtra suitable for wild buffalo. The destruction of the habitat and disappearance of grass patches and clearings due to over grazing by domestic cattle, the ever increasing net work of roads into inaccessible areas, charcoal ovens along the river banks, the continuous round the clock heavy commercial vehicle traffic, the opening of new mining complexes around Surajgarh etc., jeopardises the occurrence of wild life and the wild buffalo has become a legend.

SUMMARY

It can be safely concluded that the wild buffalo has disappeared from South Chanda Division of Maharashtra for quite some time. The forest has lost the suitable habitat which once supported a few localised herds. One can see glimpses of their habitat in the adjoining Bastar District where few herds still survive near the perennial Indravati river.

ACKNOWLEDGEMENTS

Our thanks are due to Mr. Moon, Chief Wildlife Warden for permission to undertake the survey and also to use the facilities of Forest Rest Houses; to Dr. Salim Ali and Bombay Natural History Society for giving all assistance and financial help in undertaking the survey: to Dr. V. D. Divekar, Mr. Madhav Naik, R.F.O., Bhamragarh, Mr. Oturkar, Mr. Chopra and other investigators who helped us in conducting the survey; to Shri S. N. Bande, D.F.O., Bhamragarh Div. for providing the help of forest personnel and forest Rest Houses; and to tribal guides who gave valuable information and lastly, to Dr. Prakash Amte and his friends who gave valuable suggestions for conducting the survey.

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P. B. SHEKAR

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BOMBAY 400 023,
November 23, 1979.

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2. COURTSHIP AND MATING IN THE INDIAN SHEATH-TAILED BAT, *TAPHOZOUS LONGIMANUS LONGIMANUS* (HARDWICKE)

Courtship and mating of bats in natural condition are little known. Khajuria (1972) observed these activities in *Rhinopoma h. hardwickei* Gray. Gopalakrishna (1954, 1955), Ramaswamy (1961) and Madhavan (1971, 1978) have studied the breeding habits of several species of bats but have not covered courtship and mating. We had the opportunity of observing courtship and mating in *Taphozous l. longimanus* which is reported here.

The observation was made at Krishnanagar, Nadia district, West Bengal, on 6 December 1981 at about 16.30 hours. There were four specimens of this species, a male and three females hanging in a deserted room of a hut. While searching for the presence of other species of bat in association with this species inside the room, we saw that suddenly the male bat started flying and it reached near one of the females. We thought that the bat was disturbed by our presence. But it remained quiet for about two minutes and then started crawling towards the female. The male fondled the back of the female with its muzzle. At first the female tried to push him away by moving its wings but ultimately surrendered and allowed the male to keep the muzzle on its back. Now the male placed the distal end of its forearms between the legs and wings of the female but kept the legs behind those of the female. Thus the ventral side of the male came in close contact with the back of the female. After a minute the female turned its tail aside to give way to the male to copulate. The male lifted its tail up and bent its hind portion of the body inwards to copulate. The copulation lasted for 30 seconds. It was accompanied by quick shivering movements of the body. Thereafter they separated. The male relaxed expanding its wings. The female flew away to another side of the room and rested. After a few minutes the male again started flying and approached another female of the group for copulation. It repeated the same performance. Thus the bat copulated with the two females within half an hour. No further copulation was seen in the roost upto 18.00 hours after which the observation was discontinued.

ZOOLOGICAL SURVEY OF INDIA,
8, LINDSAY STREET,
CALCUTTA 700 087,
January 27, 1982.

J. P. LAL
D. K. BISWAS

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3. A NOTE ON THE STATUS OF THE FLYING SQUIRRELS OF DARJEELING AND SIKKIM

Six species of flying squirrels, namely, the Hairy-footed Flying Squirrel, *Belomys pearsoni* (Gray), Lesser Giant Flying Squirrel, *Petaurista elegans* (Muller), Hodgson's Flying Squirrel, *Petaurista magnificus* (Hodgson), Gray's Flying Squirrel, *Petaurista nobilis* (Gray) and Particoloured Flying Squirrel, *Hylopetes alboniger* (Hodgson), are known to occur in the Darjeeling District, West Bengal, and Sikkim. A single example of the Woolly Flying Squirrel, *Eupetaurus cinereus* Thomas, which has until recently been known only from Kashmir, has also been found in Sikkim (Agrawal and Chakraborty, 1970, *J. Bombay nat. Hist. Soc.*, 66(3): 615-616). These flying squirrels occur from lower altitudes to approximately 2300 metres. *Petaurista elegans* has, however, been reported at about 3600 metres in Darjeeling district.

From records of the various species till early this century, it would appear that these flying squirrels were in abundance in one or the other place of these hilly terrains. However, during the last few decades, these montane forests, the natural habitat of the flying squirrels, have been denuded by man for extension of human settlements, plantations, terrace cultivations, road construction, ever-increasing pressure of forestry activities (such as large-scale felling of trees for timber, charcoal manufacture, etc.) and collection of firewood by local people, have limited the forest zone there to its minimum. Consequently, there has been a gradual decline of tall, well-branched suitable trees for their nesting purposes and safety from predations, as well as dearth of plants supplying their natural food, such as fruits, nuts, cones, etc.

In the course of studies on the flying squirrels in Sikkim and Darjeeling District of West Bengal from June 1974 to April 1982, we have noticed that the populations of the Lesser Giant Flying Squirrel, Hodgson's Flying Squirrel, Particoloured Flying Squirrel, Hairy-footed Flying Squirrel, etc. have been greatly depleted. These flying squirrels are now rarely seen, though the Gray's Flying Squirrel is seen in small numbers at altitudes between 1000 and 2300 metres. The main cause for their disappearance from these areas is the wanton destruction of their habitats, obviously affecting their breeding. To some extent their population is also partly affected by unauthorised killing of these animals for their beautiful pelt used in the preparation of jackets, caps, gloves, etc.

It is suggested that immediate investigation should be undertaken to study their exact status and biology for formulating measures for the conservation of these important animals.

Zoological Survey of India,
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R. K. GHOSE
T. K. CHAKRABORTY

4. UNUSUAL FEEDING BEHAVIOUR OF NILGAI

On May 1976 at Nawegaon Lake in Bhandara District a large adult Nilgai (*Boselaphus tragocamelus*) was seen near a moving terrapin. The Nilgai placed its right fore foot on the terrapin which froze. The Nilgai appeared to have pressed the terrapin, whose neck protruded out, the Nilgai grabbed the neck and pulled out the head, neck, part of the body with the viscera and ate it.

I enquired with the local Gond tribals, and Shri Madhav Patil of Paoni, a naturalist and well known Shikari who confirmed that they had observed Nilgai feeding on terrapin.

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Forest Development Corporation Ltd.,
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November 5, 1982.

M. B. CHITAMPALLI

5. THE QUILLS THAT MAKE A RED PORCUPINE

While trekking in the Valliyur Reserve Forest and looking for evidence of Wildlife on 8-8-1979, a Porcupine quill, which had red black bands, instead of the usual white and black was found. Intensive search of the area resulted in the collection of a few more red and black banded quills at various places within the Valliyur Forests upto the foot hills. Freshly fallen quills were met with and collected throughout the year. Normal coloured, i.e., black and white banded quills were not noticed in this area though they were found in adjoining areas.

From the distribution of these quills, charactertistic cheroot shaped faecal droppings and leading foot prints, a den of Red Porcupine was located and watched. "Monolick" and common salt were placed under a ledge nearby, Red Porcupine occupying the den had been using the salt licks. In August'80 (13-8-1980) a partially decayed carcass of Red porcupine was found. The quills were intact and in position on to the dried skin. Their measurements and weights are given below:

1. Quills on the crest, reddish orange or blackish orange thin, hairlike in appearance directed backward erectile,. not banded.

Maximum length = 30 cm.
Minimum length = 15 cm.
Average length = 25 cm.
Total numbers = 672
Total weight = 12 grams.

2. Quills on the back, flexible to form C and resilient when one end is released springs back straight, about 6% of the quills of this category are black and white banded.

	a) Red and white banded	b) Black and white banded
Maximum length	= 46 cm.	30 cm.
Minimum length	= 12 cm.	17 cm.
Average length	= 25 cm.	22 cm.
Total number	= 152	9
Weight	= 67 grams.	2 grams.

3. Quills on the small the back (short, stout, strong) sharp pointed some with longitudinal furrows.

	a) Red and white banded quills.	b) Black and white banded.
Maximum length	= 22 cm.	19 cm.
Minimum length	= 3 cm.	5 cm.
Average length	= 10 cm.	10 cm.
Weight		21 grams.
Total number		69

Short corrugated quills
= 168 Nos. 40 grams.
Long corrugated quills = 64 Nos. 71 grams.

4. Unbanded (one colour quills on the back).

	a) All Red	b) All white
Maximum length	= 14 cm.	26 cm.
Minimum length	= 5 cm.	5 cm.
Average length	= 9 cm.	15 cm.
Total number	= 110	50
Weight	= 31 grams.	8 grams.

5. Quills under tail:

The petal like cupules are tubular some with cups. These appears like "elongated stemless wine glasses" produce a sort of clapping sound like that of a rattel. Colour of all the nine quills were orange or reddish orange. Short spines of reddish or blackish red colour were spread all over the body.

Maximum length = 9 cm.
Minimum length = 5 cm.
Average length = 6 cm.
Total number = 11
Weight = 2 grams.

6. Quills all over the body above 3 cm.
Total 64 Nos. 71 gms.
Havilike spines — Weight 14 grams.
Total — 928.

These quills are kept in the museum of the wildlife Warden, Kalakad Sanctuary, Tirunelveli-11.

From the present evidences of distribution temporal frequency of fallen quills and the following observations are made.

1. The Red Porcupine occurs also in areas which do not have a red or orange ground colour.
2. The red colouring of quill is not a seasonal factor.
3. A very small percentage of black and white banded quills, all white and all red quills were found on the back of the animals.
4. The all white and all red quills are arranged in such a way so as to form red and white bands on the body of the animal.
5. Evidences of red Porcupine have not been found in other parts of Kalakad Sanctuary, Mundanthurai Sanctuary, Anamalai Sanctuary and Mudumalai Sanctuary.
6. The population of red Porcupine in Kalakad Valliyur Forests is estimated to be between 40 and 50.

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October 25, 1982.

6. BIRDS FEEDING ON FIRE-DRIVEN INSECTS

In the Sauraha area of Nepal's Chitwan National Park, permitted burning and harvesting of Elephant grass by local inhabitants took place daily from 25th January to 3rd February 1981, when we were birdwatching in this area.

On many occasions we came across groups of Black Drongos (*Dicrurus macrocercus*), feeding on insects driven upwards by the advancing flames. Aerial prey capture appeared to be extremely easy, even amidst thick rising smoke — the birds usually returning to grass-stem perches before another foray above the fire.

Ali and Ripley (1968-1974), mention this behaviour in their account of Black Drongo feeding habits. However, on 31st January we observed 4 Ashy Drongos (*Dicrurus leucophaeus*), and 30+ Ashy Wood-Swallows (*Artamus fuscus*), feeding in a similar manner with *c.* 50 Black Drongos. The Wood-Swallows usually fed at a greater height than the Drongos, and were never seen to land. In addition, 3 Black-shouldered Kites (*Elanus caeruleus*), fed low over the same area, also in close association with the fire-front, and were thought to be looking for fleeing small terrestrial prey.

In view of the large number of insects driven out of such an area it is perhaps surprising that no more species were seen capitalizing on this rich food supply.

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REFERENCE

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7. OCCURRENCE OF THE GREAT CRESTED GREBE, *PODICEPS CRISTATUS* (LINNE) AT RANCHI, BIHAR

In November last Mrs. Marie Palit who lives at Ranchi, Bihar, wrote to me about some water birds which had over the last few years started visiting the water-supply lakes nearby. They occurred in large numbers over 300 at a time. Mrs. Palit said that they resembled a large grebe a picture of which she sent me from an American magazine and I suggested that it may be the Great Crested Grebe, *Podiceps cristatus* (Linné) of which the nearest record appeared to be one(?) seen by Mr. Horace Alexander (INDIAN HANDBOOK 1 p. 3) at Puri, Orissa.

In the meantime, my wife visited Ranchi and Mrs. Palit took her down to one of the lakes and they saw 40-50 birds in the distance. The lake was clear of weeds. Later Mrs. Palit sent in pieces of two specimens which are no doubt of this species. I wrote to Mr. Alexander for more information but though he remembered that he saw it in December 1946 in Orissa he did not recollect whether this was on salt or fresh water but the fact that he wrote to Sálim Ali must mean, he said, that it was a relatively exciting record. He wrote again saying he had found his notebook which referred to 40-50 birds at Puri Lake on 25 December 1946 and again an uncounted number seen on 1st January 1947.

This species is accepted as a winter visitor entering from the north-west, extending as far south as Gujarat in the west and eastwards along the north into Assam and Manipur. On the eastern side the southernmost record is the one from Puri referred to above while Inglis quotes a few records from much further north in the Madhubani Sub-Division of Darbhanga District in Tirhut (JBNHS 16 p. 342). The present records are from over 200 miles southwards, but Mrs. Palit was informed that they have been seen here over the last few years only. They are locally known as Siberian duck and often caught at night in nets laid for fish.

In her last letter Mrs. Palit said one was obtained on 13th March, "when only about 100 birds were left, and all had gone by 20th March".

In the absence of earlier records it would appear that they have started visiting this area in fairly recent years and it would be interesting to try and determine to what factor this change in migratory limits further southwards can be attributed.

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March 25, 1982.

HUMAYUN ABDULALI

8. WINTER FOOD OF SPOTTED OWLET, *ATHENE BRAMA INDICA*

A group of six Spotted owlets, *Athene brama indica* which roosted on a *Eucalyptus camaldulensis* very close to our laboratory, were regularly observed to study their social behaviour. We also analysed their faecal pellets during winter to study their food. The identifiable contents were sorted from the faecal pellets and analysed by gravimetric method (Table 1) following Southern (1969).

It is observed that during the month of December about 60 per cent of their food was composed of various types of insects but during January their food consisted pre-dominantly of rodents (60.2%). The mandibles which were found intact in the faecal pellets were identified to be mostly of the Field mouse, *Mus* sp. *Eucalyptus* seeds, small pebbles and lime particles also occurred in the faecal pellets. Apparently they are taken for assisting in the grinding of food.

In the Central Research Farm of the Institute (about 400 hectares) the rodent population is constituted mostly by *Tatera indica* (43.8%), *Meriones hurrianae* (28.9%), *Gerbillus nanus indus* (24.0%) but other rodents also occur in low numbers: *G. gleadowi*

TABLE 1

PER CENT OCCURRENCE OF VARIOUS UNDIGESTED ITEMS IN THE FAECAL PELLETS OF *Athene brama indica*

Items	1st week of December	Last week of January	Ave. winter food
INSECTS	59.79	34.15	46.7
Hemiptera	4.68	2.43	3.5
Hymenoptera	0.85	1.62	1.2
Coleoptera			
Carabidae	1.71	3.25	2.5
Scarabaeidae	23.50	0.81	12.0
Tenebrionidae	18.80	14.63	16.7
Misc. unid. insects	10.25	11.41	10.8
RODENTS	28.19	60.22	44.2
Jaws, bones of Rodents	9.40	18.76	14.1
Fur	0.85	0.81	0.8
Semi-digested material	17.94	40.65	29.3
PLANT MATTER			
Eucalyptus seeds	1.28	0.81	1.0
PEBBLES	11.96	4.06	8.0

(0.82%), *Funambulus pennanti* (0.82%), *Rattus meltada pallidior* (0.82%), *Mus* sp. (0.82%) and *Golunda ellioti* (present) (Prakash and Rana 1970). It is, therefore, surprising to observe that though the occurrence of *Mus* sp. is minimum in the natural environment, yet the presence of this species in the faecal pellets of owlets is maximum. This observation suggests three points worthy of consideration. 1. It is quite possible that the Spotted owlet is unable to handle and capture the larger nocturnal gerbil, *Tatera indica* (100 g body weight) and, therefore, it is not preyed upon, 2. The Spotted owlet is a selective feeder and picks up only *Mus* spp. though they are not very common, 3. It's in-efficiency to capture the typical desert rodents like *Gerbillus gleadowi* and *Gerbillus nanus* which are nocturnal as well as of the 10 to 20 g. body weight, is because of the specialised adaptation possessed by these rodents pertaining to hypertrophy of tympanic bullae due to which these small mammals can perceive and discriminate between the wing beats of predatory as well as non-predatory birds (Prakash 1959). As such the typical desert rodents are able to escape from owlets' attacks, but *Mus* spp. fall an easy prey to them.

There could be still another reason of Spotted owlets shifting their food from insects to rodents. Their breeding season at Jodhpur starts in February and to prepare for reproduction they switch over to more nutritive and high protein rodent food.

ACKNOWLEDGEMENT

We are grateful to Dr. H. S. Mann, Director, Central Arid Zone Research Institute, Jodhpur for providing facilities and encouragement.

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RANJAN ADVANI

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CENTRAL ARID ZONE RESEARCH INSTITUTE,
JODHPUR,
December 3, 1981.

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9. OCCURRENCE OF NORTHERN JUNGLE MYNA *ACRIDOTHERES FUSCUS* WAGLER IN THE PUNJAB AND HARYANA

The nominate race of the Jungle Myna *Acridotheres fuscus* has been accepted as occurring over most of northern India, excluding the desertified areas. There do not appear to be any specific records from the Hoshiarpur and Ludhiana districts, and it is also omitted from the Checklist of the Birds of Delhi, Agra and Bharatpur.

It may, therefore, be worth recording that since August 1979, we have seen this bird at the following seven places:

(i) Bias Pind (district Jullundur); (ii)

Tanda Urmur (district Hoshiarpur); (ii) Ludhiana; (iv) Khanna (district Ludhiana); (v) Kurukshetra; (vi) Bilaspur (district Ambala); (vii) Jagadhari (district Ambala). the first four being in the Punjab and the last three in Haryana.

They were usually in small parties of about 10 birds restricting themselves to the outskirts of villages and often accompanied by the Common and Bank Mynas.

It is possible that there are some local movements of this species which have prevented its having been seen more often.

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LUDHIANA 141 004, PUNJAB,
April 13, 1982.

REFERENCE

ABDULALI, HUMAYUN & PANDAY, JAMSHED D. (1978) Checklist of the Birds of Delhi, Agra and Bharatpur. Bombay.

10. RUSTIC BUNTING (*EMBERIZA RUSTICA*) — A NEW SPECIES FOR NEPAL

(*With a text-figure*)

On 31st January 1981 we discovered a ♂ Rustic Bunting (*Emberiza rustica*), feeding with *c.* 15 Little Buntings (*Emberiza pusilla*), near Sauraha in the north-eastern region of Nepal's Chitwan National Park.

Observations were made over 40 minutes as the bird fed and called in very similar manner to the Little Buntings. The birds were watched at distances down to 20 metres in an area of low, scattered bushes on the edge of a dry heavily-grazed plain bordering Rapti Dun. The most striking differences from the marginally smaller Little Bunting are:

(i) A broad, rich chustnut pectoral band, extending as chevrons down the flanks and contrasting markedly with the otherwise clean white underparts.
(ii) Head pattern essentially bold black/white zones, lacking the chestnut ear-covert patch.
(iii) Chestnut-tinged nape patch.
(iv) White median spot on the rear of the crown.
(v) When alarmed, a conspicuous tufted crest is visible.

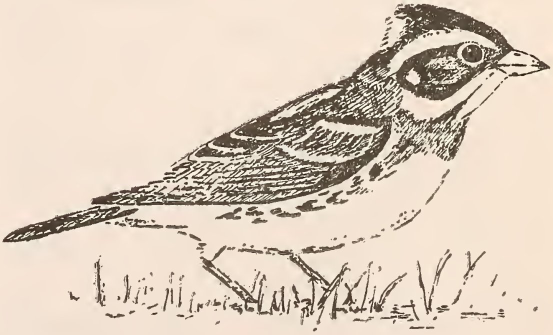

Fig. 1. Rustic Bunting (*Emberiza rustica*), male.

We are familiar with this species as a migrant in Great Britain, and feel that this bird was a ♂ in view of the distinct black head-markings (more diffuse and browner in a ♀), and general 'smartness' of the underparts.

Walters (1980) reports that this species breeds in the north-taiga zone of Eurasia, wintering south to Japan and East China; King *et al.* (1978), give it migrant status in Taiwan. To the best of our knowledge there is no previous record of Rustic Bunting from Nepal or India, (T. P. Inskipp informs us that another individual was reported from Nepal later in the spring of 1981).

CALF OF MAN BIRD OBSERVATORY,
ISLE OF MAN, U. K.

ADRIAN DEL-NEVO

EDWARD GREY INSTITE OF FIELD
ORNITHOLOGY, DEPT. OF ZOOLOGY,
SOUTH PARKS RD., OXFORD., U.K.,

PETER J. EWINS

April 14, 1982.

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11. OBSERVATIONS ON FOOD REQUIREMENT AND FOOD CONVERSION IN THE MUGGER (*CROCODYLUS PALUSTRIS*) REARED IN CAPTIVITY

(*With two text-figures*)

The present paper is based on observations made on 15 mugger crocodiles (*Crocodylus palustris*) which were reared between 1975 and 1980 at the Gharial Research and Conservation Unit (GRACU), Tikerpada, Orissa, a place within the distributional range of the species. Hatchlings were reared in pens of 4 x 4 m area with a central pool of 2 x 2 x 0.3 m in size. Older mugger were kept in yearling pens of 6 x 6 m size with a pool of 4 x 4 x 1 m. All mugger were reared under ideal husbandry conditions described by Bustard *et al.* (in press).

The initial number of 15 mugger was reduced to 13 at 6 months, 10 at 45 months and 6 at 53 months due to transfers from GRACU to other rearing/breeding centres. Out of a total of 4,855 Kg of food given to these mugger only about 60 Kg (1.2%) consisted of 'undressed' mammalian (wild boar, sambar, cheetal, rat and civet) and reptilian (freshwater terrapins, snake and crocodilian), meat and birds (crow, country fowl, pigeon and owl), the rest consisted of a mixed variety of fish species and prawn collected from the adjacent Mahanadi river. The low composition of non-fish items in the diet was a result of non-availability of these. The 'sport meat' fed were purchased by the project during auction of 'seized meat' by the department.

Food quantities have been calculated from actual amounts the mugger had eaten till satiation. The frequencies of feeding were every other day during summer and autumn, and 2-3 days per week during the winter and rains. Hatchlings up to 9 months old were provided with live fish in their rearing pools. Hence, they fed every day as per their requirement. Non-living food were provided in the enclosures mostly between 9 and 11 a.m. and occasionally in the evening. Day-time feedings followed removal of uneaten food ofter an hour. Left-overs from evenings were removed on the following morning.

The food requirement of hatchlings was proportionately high, over 3-5% of the body weight. The requirement gradually lowered down to below 1% when the mugger were 5 years old and about 45 Kg in weight (Figs. 1 and 2). Table 1 shows that food intake was the lowest during winter and maximum during summer, through rain and autumn.

The food conversion (Table 2) was 12.4% during the first year, 22.9% during the second and 16.8% during the third. The mean conversion at the end of the third year 18.2%

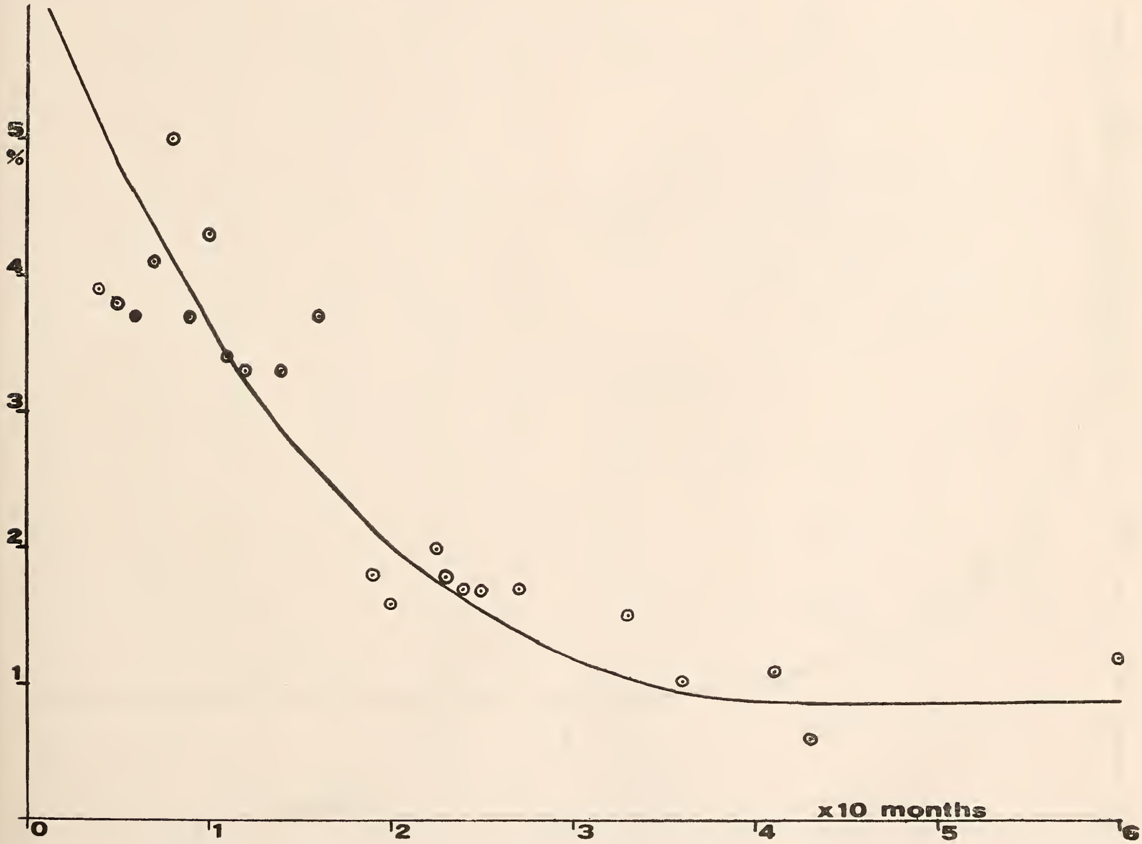

Fig. 1. Relationship between the percentage of body weight eaten by mugger at different months of age. Fluctuations off the curve are a result of seasonal impact.

and at the end of the fifth year 12.4%. There was evidently a decrease in conversion in the later years.

B. C. Choudhury (pers. comm.) comments that his mugger at Nehru Zoological Park, Hyderabad, fed with almost entirely meat diet show a lower food consumption rate but almost similar growth rates, therefore, a higher conversion rate.

Only fragmentary information are available on the growth of mugger in the wild (Acharjyo and Mohapatra 1978; Choudhury and Bustard 1982), but there are none on their food conversion in the wild. However, there are a few publications providing evidence of a mixed-diet habit for the mugger. Stomach examination of shot-down mugger have shown the presence of, other than fish, aquatic beetles and bugs (D'Abreu 1915; McCann 1935, 1940), mollusc and *Rana tigrina* (D'Abreu 1915), pig (Pitman 1913 a), goat (Simcox 1905), and humans (Shortt 1921, Krishnamurthy 1951). Pitman (1913 b) had seen a dead panther on a river bank whose nature of injury suggested that it was attacked by a crocodile. Evidence or information about

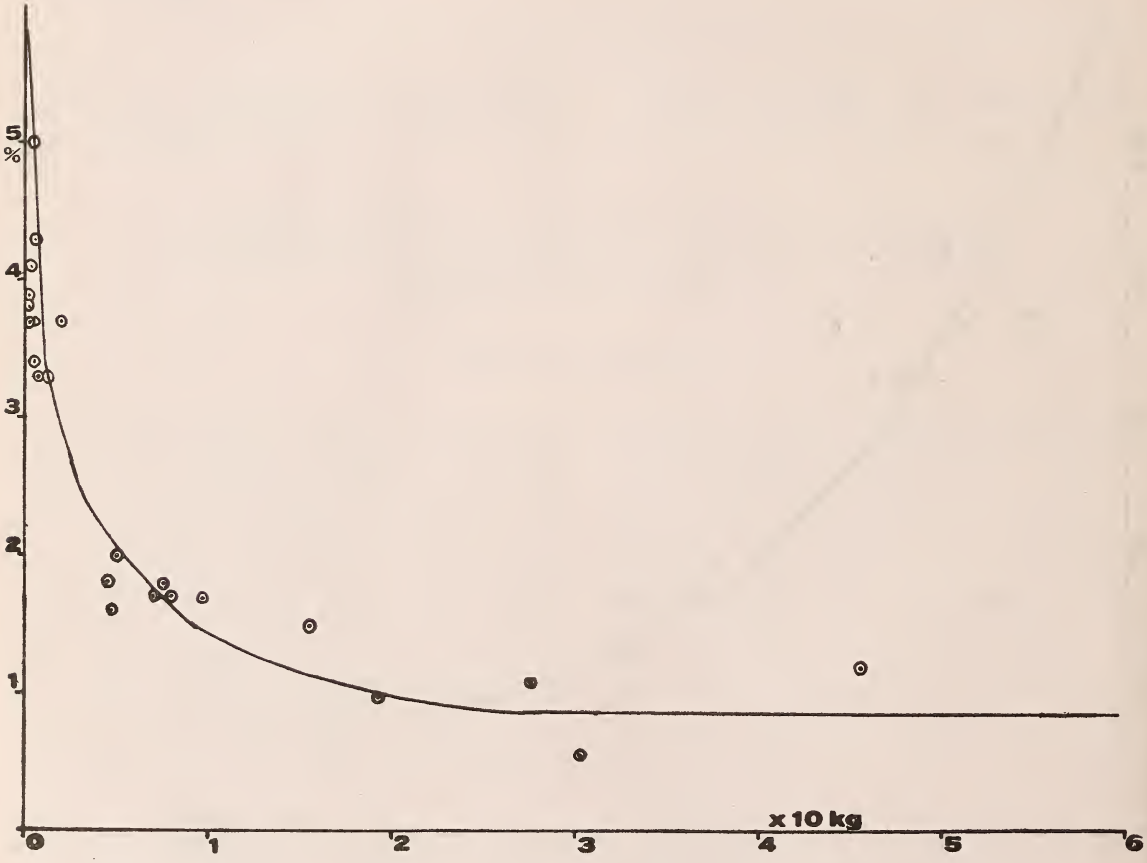

Fig. 2. Relationship between the percentage of body weight eaten by mugger at different body weight. Fluctuations off the curve are a result of seasonal impact.

Table 1

Per day food requirement of the mugger (*Crocodylus palustris*) in captivity during the first five years

Month	Age in months	TBL (m)	W (gm)	F (gm)	F x 100 / W
June	1	—	—	8	—
July	2	—	—	8	—
Aug	3	—	—	10	—
Sep	4	438	307	12	3.9
Oct	5	445	320	12	3.8
Nov	6	458	344	12.8	3.7
Dec	7	460	372	15.3	4.1
Jan	8	465	406	20.5	5.0
Feb	9	470	440	16.6	3.7
Mar	10	500	500	21.7	4.3
Apr	11	511	596	20.5	3.4
May	12	543	760	25.6	3.3
June	13	—	—	28.2	—
July	14	674	1305	43.5	3.3
Aug	15	—	—	29.4	—
Sep	16	749	2135	79.4	3.7
Oct	17	774	—	79.4	—
Nov	18	—	—	79.4	—
Dec	19	835	4505	83.8	1.8
Jan	20	849	4865	80.2	1.6
Feb	21	—	—	78.0	—
Mar	22	877	4985	102	2.0
Apr	23	888	5569	102	1.8
May	24	941	7000	120	1.7
June	25	981	7941	134	1.7
July	26	—	—	137	—
Aug	27	1084	9679	165	1.7
Sep	28	—	—	191	—
Oct	29	—	—	211	—
Nov	30	—	—	207	—
Dec	31	—	—	151	—
Jan	32	—	—	182	—
Feb	33	1290	15465	228	1.5
Mar	34	—	—	237	—
Apr	35	—	—	203	—
May	36	—	—	206	—
June	37	1483	19344	186	0.96
July	38	—	—	286	—
Aug	39	—	—	232	—
Sep	40	—	—	279	—
Oct	41	1654	27549	309	1.1
Nov	42	—	—	200	—
Dec	43	1696	30276	173	0.57
Jan	44	—	—	143	—
Feb	45	—	—	292	—
Mar	46	—	—	336	—
Apr	47	—	—	382	—
May	48	—	—	428	—
June	49	—	—	307	—
July	50	—	—	334	—
Aug	51	—	—	414	—
Sep	52	—	—	510	—
Oct	53	—	—	544	—
Nov	54	—	—	565	—
Dec	55	—	—	434	—
Jan	56	—	—	473	—
Feb	57	—	—	480	—
Mar	58	—	—	522	—
Apr	59	—	—	477	—
May	60	1968	45470	544	1.2

Table 2

Yearly food conversion in the mugger

Age in months	Growth in length (TBLG cm)	Growth in weight (WG Kg)	Total food (TF Kg)	TBLG x 100 / TF	WG x 100 / TF
Hatching to 1 year	26.3	0.685	5.49	479.0	12.4
1-2 year	39.8	6.240	27.15	146.5	22.9
2-3 year	54.2	12.344	73.14	74.1	16.8
Total for 3 years	120.3	19.269	105.78	113.7	18.2
3-5 years	48.5	26.126	259.92	18.6	10.0
Total for 5 years	168.8	45.395	365.7	46.1	12.4

The length and weight at hatching have been considered as 28 cm and 75 gm respectively.

vegetable matter in the stomach are given by D'Abreu 1915 (14 paddy grains), Simcox 1905 (lilly stalks), and Abdulali 1938 (fallen fruits of *Ficus glomerata*). Faecal matters were examined in the field by Whitaker (1978) in the Gir and Vijaya (1981) at Sathanur. Whitaker saw remains of cattle egret feathers, fish scale and water snake, and Vijaya saw "feathers". In the Satkoshia Gorge I had seen the pug marks of a mugger, about 3 m long walking up and down the river bank to a distance of about 50 m away from water where remains of a giant squirrel were lying. With B. C. Choudhury and trainees of Central Crocodile Breeding and Management Training Institute, Hyderabad, I was in Manjira in Andhra Pradesh during December 1981, when in the evenings we had seen hatchling mugger feeding on insects attracted to the beam of light from our spot-lights.

As shown in Table 2, for every 100 Kg of food (here predominantly fish and prawn) the growth were 113.7 cm and 18.2 Kg during the first 3 years, and 46.1 cm and 12.4 Kg during the first 5 years. It will be extremely interesting to watch for the results of current studies done elsewhere on the species and compare the above conversion rates obtained for a predominantly fish-prawn diet with rates for other diet. The experience in captive rearing is that through a change from a monotonous diet certain osteological problems can be rectified at an early stage, the results of current studies will also enable in selecting an economic diet with high conversion rate and no morphological or physiological complications. This is very important for a country like India which through a rigorous conservation phase is optimistically looking forward to a commercial phase. Besides, the studies will be of considerable academic significance when information for different species are available.

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I wish to record my gratitude to the Orissa Forest Dept., Govt. of India, U.N.D.P. and F.A.O. for provision of help and facilities of different kinds. B. C. Choudhury provided useful suggestions and information.

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12. STUNTED GROWTH IN CAPTIVE-REARED GHARIAL

Capitive-reared crocodilians are often very stunted as a result of inadequate husbandry conditions with consequent delay in attainment of sexual maturity (Bustard 1980). This situation also obtained with many/most gharial reared in Indian zoos prior to the initiation of the Government of India/FAO/UNDP Crocodile Breeding and Management Project in 1975.

Nehru Zoological Park, Hyderabad, purchased two gharial from a dealer on 18 August 1966. Presumably they were freshly caught. At this time they measured 1 m and 70 cm respectively and are known to have originated from Patna. These invididuals were measured by us on 12 August 1979 and thereafter at six monthly intervals. The growth data are given in Table 1.

These individuals were shifted to the State Crocodile Complex, located within the Nehru

Table 1

Growth of a pair of sub-adult gharial at Nehru Zoological Park, Hyderabad (length in m)

Date	Length	
	Male	Female
18-8-66	0.70[1]	1.0
12-8-79	1.95	2.28
8-1-80	1.97	2.28
20-9-80	1.97	2.28
7-4-81	1.98	2.28

[1] The smaller (=younger) individual remained smaller throughout (Gowhar Ali Khan, pers. commn.)

Table 2

Feeding regime January 1980 — January 1981 inclusive (weights in kg)

Month/year	Food provided	Dead fish removed	Food consumed
January 1980	10	3	7
February	10	4.3	5.7
March	17	4	13
April	12.5	2.5	10
May	10.5	1.4	9.1
June	10	—	10
July	5.9	—	5.9
August	7.7	0.2	7.5
September	13.5	1.5	12
October	11	—	11
November	10.4	1	9.4
December	12	1	11
January 1981	4	0.5	3.5

Zoological Park, on 8th January 1980 and thereafter their food consumption is known. The food fed, together with uneaten food removed, is given in Table 2 from which actual food consumption is calculated.

During the period August 1979 to April 1981, the female showed no recordable growth, and the male increased by only 3 cm.

These data are important as they indicate continuation of stunted growth even after rehousing and provision of a good, regular, fish diet.

The accommodation of these gharial prior to the transfer to the complex was in an enclosure with a 7 x 3 x 0.5 m deep pool with a 2 m land surrounding where they were housed together with three mugger crocodiles of 2.7, 2.3 and 1.6 m. all males. When housed in this enclosure the gharial used to enter the pool only when the mugger were on land. For the larger part of the day both gharial were at one corner of the enclosure. During the winter months, however, they started moving in the pool as the mugger occupied a burrow which they had dug under the wall.

The animals were fed once weekly with 2 kg of live fish and 5 kg of beef (which gharial do not take). The gharial fed only on the live fish not eaten by the mugger, as they were victims of the more aggressive mugger particularly during feeding times.

Following transfer to the complex the gharial were housed in a yearling pool measuring 5 x 4 x 1 m deep with a land area of 1.5 m surrounding the pool. They seldom/never basked.

Gharial hatch in June and at the time of obtaining these (August) the 70 cm individual was clearly a yearling being then 13-14 months old, and the 1 m individual was most likely to be 25-26 months old. Hence in 1979 these animals were 14-15 years old. Bustard and Singh (1980) provided growth data on young gharial at the Gharial Research and Conservation Unit, Tikerpada, Orissa, for their first 4½ years of life. At three years their length averaged 218 cm with a range of 193-222 cm. Hence the two Nehru Zoological Park gharial at 14-15 years old were only the size of three year-olds showing normal growth. In crocodilians attainment of sexual maturity is size-related. The male, the sex of which was confirmed by cloacal probing and extrusion of the penis, which measured 4 cm, showed no signs of *ghara* development at a length of 1.98 m.

These data represent the most complete instances of stunted growth in the gharial known to us.

The male died on 8-4-1981 due to unknown causes being in good health the previous day. Dissection confirmed it to be completely sexually immature.

We also have growth data for two gharial reared at the Madras Snake Park between 1974-1976. Growth data for these two individuals, which also showed stunted growth are shown in Table 3. An individual measured 82 cm in June 1974 and should have attained about 110 cm in February 1976, (it was 96

TABLE 3

GROWTH OF TWO GHARIAL AT MADRAS SNAKE PARK, TAMIL NADU (LENGTH IN CM)

Date	Length	
	Individual 1	Individual 2
9-6-74	82.5	—
13-11-74	82.0	—
5-3-75	—	132*
9-5-75	92.5	132
22-2-76	96	135

* Obtained same day from Ahmedabad Zoo.
Note: Both individuals are thought to be females.

cm) and the individual which measured 132 in March 1975 after a year should have measured 180-190 cm instead of a virtually unchanged length of 135 cm.

It is interesting to compare the growth rates in Orissa, at Nandankanan Biological Park, the only place to successfully breed gharial in captivity (Bustard & Maharana 1980). The male measured 135 cm in March 1963 (when it was considered to be 33 months old (Singh 1978) after 10 years it measured 2.5 m. Juvenile growth data recorded on a large number of gharial, at the Gharial Research and Conservation Unit, Tikerpada, also in Orissa, Bustard & Singh (1980) indicated that this growth was obtained on an average in two years at the time the gharial were 4 years old. Whereas the above male at Nandankanan showed an annual growth rate of 11.5 cm/year, the Tikerpada individuals were growing over the same size range at an average of 53 cm/year, or more than 4½ times the growth achieved at Nandankanan, where the climate is also similar to that of Tikerpada. Clearly, therefore, this Nandankanan male was also stunted, as were the two females reared with the male which attained lengths of 2.5-2.65 m at an age of 12 3/4 years. In one year between January 1973 and January 1974 the 2.5 m male grew by only 6 cm, in two further years by 14 cm, and then showed no growth at all in the following year (Biswas, Acharjyo & Mohapatra 1978). Bustard and Maharana (1981) provide recent growth data for this group of gharial now rehoused in the breeding pool.

ACKNOWLEDGEMENT

We thank Mr. R. Whitaker for allowing us to present growth data for the two juvenile gharial at the Madras Snake Park.

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13. A SPECIAL METHOD OF FISHING FOR JUVENILES OF MAHSEER (*TOR PUTITORA*) IN THE STREAMS OF HIMACHAL PRADESH

Besides the traditional methods of catching the mahseers and other hill stream fishes, some interesting fishing devices are also practised in Himachal Pradesh, especially for 'baiting' mahseers. The method described in the present communication is ingenious and specialised for catching the juveniles of mahseer (*Tor putitora*) and is mainly operated in the rapid and rocky streams of Western Himalayas. Though the method is based on luring the fish to the bait as described by Motwani & Srivastava (1961) for 'garua' fishing in the Ganga river system, the operation is quite different in the fast flowing mountain streams.

The method is quite prevalent in Kangra, Hamirpur and Bilaspur districts of Himachal Pradesh. It is effectively operated in the shallow parts of the streams throughout the year, except during the rains when the hill streams are swollen with flood waters. It was observed that one person, in a single operation on 31-viii-1980, collected 22 mahseer juveniles from Sheerkhad near Jhanduta in Bilaspur district of Himachal Pradesh. The operation was repeated again on the same day at three spots within 2 km stretch of Sheerkhad and the number of mahseer collected ranged from 17 to 32 in two hours. The size of fish collected by this method ranged between 98 and 212 mm.

The success of the operation mainly depends on the preparation of bait, allurement of fish to the bait and netting operation. For one single operation, about 250 gms of maize/what flour is added to a handful of raw cowdung and is soaked thoroughly, so that the entire mass can be used as bait in the shape of a ball. The bait in the form of a ball is then put between stones in knee-deep water in the stream. To lure the maximum number of fish, the bait should preferably be kept at such a place where the gradient of the stream ends in a deep pool and the stream floor consists of pebbles and small stones.

The penetrating smell of the raw cowdung used in the bait attracts the fish to the bait. When a considerable number of fish have been lured, the person watching the operation from a distance slowly comes near the spot and quickly covers the bait and its surroundings with a cast net. The fish thus congregated around the bait get trapped in the cast net and are collected. The operation is then repeated at the various places in the same stream till the fisherman gets a catch of commercial value.

Though the 'garua' fishing in Ganga river system is also practised by luring the fish, the operation is quite different. For 'garua' fishing the bait prepared from goat entrails, goat fat, dried cowdung and crude dolphin oil is quite expensive and is cast in small bits in the shallow parts of the river, whereas in the present operation, the bait consisting of raw cowdung and wheat/maize flour is kept as a whole in the shape of a ball in the shallow part of the stream. The netting operation in the present device is carried out by one person with the help of a cast net (1/2″ or 1″ mesh size), while in 'garua' fishing drag nets are used, employing 4 to 6 fishermen in the operation.

The fact, that only juvenile and young mahseer, to the complete exclusion of other hill stream fishes, are caught by this device is very significant. The method thus assumes greater importance when used with a view to procure stocking material for the rivers and lakes in the Indian uplands for the development of sport fisheries.

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14. OBSERVATIONS ON THE BATHYMETRIC DISTRIBUTION OF HILSA LARVAE IN MIDDLE STRETCH OF RIVER GANGA NEAR ALLAHABAD

(*With a text-figure*)

Observations on the spawning of *Hilsa ilisha* (Hamilton) made by earlier workers in different rivers more or less explain the availability of eggs and larvae in surface and subsurface layers of water. Karamchandani (1961) collected eggs and larvae of hilsa from Narmada river with the help of spawn collection net. Ravish Chandra (1962) used a surface tow net for collecting hilsa larvae from Hooghly Estuary. Pillay and Rosa (1963) observed that hilsa eggs occur in sub-surface zones, the juveniles inhabit the surface waters and the later stages move in deeper zones. But there is no information on bathymetric distribution of hilsa larvae excepting that of Ghosh & Nangpal (1968) who have determined the bathymetric preference of larvae while making collections with organdie ring net during winter breeding of hilsa in lower stretch of River Ganga. According to Ghosh & Nangpal (op. cit.), the larvae are available in surface and sub-surface layers in a total water column of 1.3 m but they have not given further split-up of this range showing depth limit. While collecting hilsa larvae from middle stretch of Ganga river, we recorded bathymetric distribution which has been given in this communication.

The distribution of hilsa larvae with regard to different depths was studied by operating a special net made of mosquito netting (1/16″ mesh), comprising three portions *viz.*, upper, middle and lower. It was almost like a set of three spawn collection nets stitched together vertically. Each of the three cod-ends of the net was tied to a cylindrical bucket of 12 cm length and 10 cm diameter, open at both the ends. The distal ends of buckets were blocked by a piece of organdie cloth to check the escape of larvae. Two bamboo poles were put at the mouth end and the three buckets, functioning at different depths, were tied to one pole at the rear end (Fig. 1). The net was 230 cm in length, 210 cm in width,

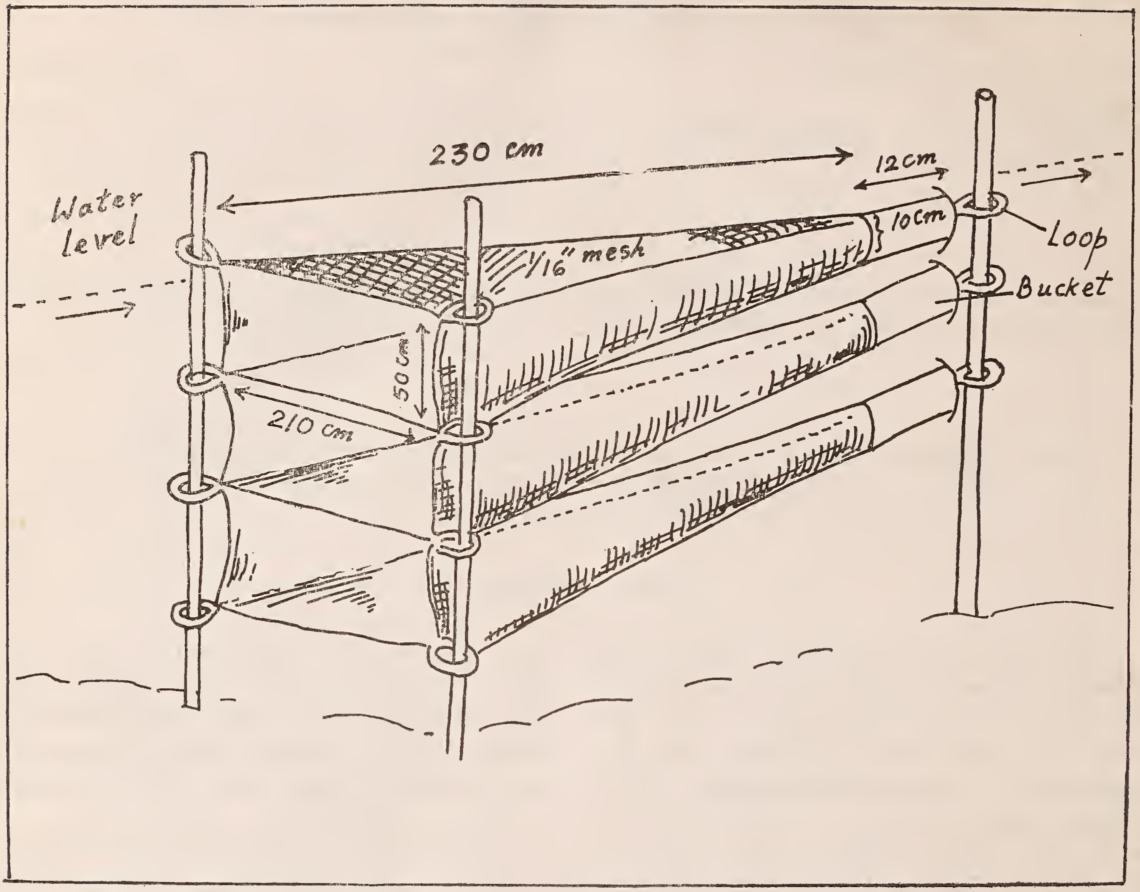

Fig. 1.

with a height of 50 cm at the mouth end and was operated in a depth of about 1.5 m.

The data collected on the availability of hilsa larvae in relation to water depth, during postmonsoon breeding of 1970 and 1971 at three centres in the middle stretch of Ganga river, are given in Table 1. The net was operated at each centre for a period of 6 hours from 10.00 a.m. to 4.00 p.m.

It is evident from the Table 1 that the larvae were more commonly encountered in the collections of upper and middle buckets thereby indicating their availability in surface and sub-surface depth ranging from 10 to 50 cm approximately whereas the number of larvae was insignificant in lower bucket i.e. in sub-surface depth exceeding 50 cm approximately.

ACKNOWLEDGEMENTS

We are grateful to Dr. V. G. Jhingran, for-

TABLE 1

AVAILABILITY OF HILSA LARVAE IN RELATION TO WATER DEPTH. (BATHYMETRIC DISTRIBUTION OF HILSA LARVAE)

Sl. No.	Date	Number of Larvae			Depth of operation (cm)		
		Upper	Middle	Lower	Upper	Middle	Lower
1.	23-10-70	12	6	Nil	18	32	58
2.	„	25	15	Nil	25	52	80
3.	„	31	14	3	22	42	68
4.	3-11-70	46	20	7	20	32	52
5.	19-11-70	17	9	Nil	24	48	75
6.	26-11-70	15	2	Nil	27	55	85
7.	26-10-71	1400	2250	25	20	40	65
8.	29-10-71	28	55	Nil	20	36	64
9.	30-10-71	1500	2700	20	25	50	83
10.	3-11-71	60	35	Nil	20	33	49
11.	4-11-71	75	95	Nil	10	30	48
12.	18-11-71	80	3	Nil	16	30	55
13.	29-9-71	18	10	Nil	20	40	60
14.	7-10-72	21	6	Nil	20	40	60
15.	15-10-72	32	16	3	20	40	60

mer Director, C.I.F.R.I., for his keen interest in the studies and to Dr. A. G. Jhingran, Head, R & L Division and Dr. A. V. Natarajan, Director, C.I.F.R.I., Barrackpore for going through the note critically and suggesting improvements. Thanks are also due to Shri J. C. Malhotra, former Head of R & L Division for his encouragement.

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December 21, 1981.

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15. OCCURRENCE OF COMMON CARP (*CYPRINUS CARPIO*) IN TROUT WATERS

Common carp (*Cyprinus carpio*) was introduced and retained in a tank at the Trout farm, Mahili (Katrain), Kulu valley of Himachal Pradesh, on the left bank of river Beas. This was during the years 1958-1962. The fish were disposed of and attempts to culture them abandoned after finding poor prospects of breeding and growth in the cold waters. Only one breeding was managed in a spring-water fed tank at a temperature of 17.5°C. There was no trace of the fish or its progeny left thereafter, as the farm tanks had been completely cleaned and dried several times and the water supply cut off several times for long periods during the gap of 17 years.

Another private farmer on the right bank of the river Beas attempted the culture of common carp in 1969 after converting a marsh fed on spring water, in a temperature range 18°C-22°C which he has continued to prospect.

A strange occurrence took place during July-August this year. Three Common carps were caught in the torrential Beas (temp. range 6°C-14°C) which sometimes flows at above 3 metres per second velocity by a trout angler using dough and turmeric bait. During the same month another Common carp 24 cm long was collected from a drying-down channel of the same trout farm at Katrain from where the fish had been completely disposed of 17 years ago. The fish when collected was in a melanic form. After collection, this was transferred to a spring water source at 17.5°C temperature. Within a fortnight the fish reverted to its natural colour.

It is certain that the fish had travelled at least 3 kilometres in the torrential, cold Beas and crossed to the other side to reach the site where it was collected, besides the journey it must have performed in the river course. The Common carp is thought to be a fish of hill impoundments, but its occurrence under such torrential conditions has not been observed earlier.

I shall be greatly obliged if readers kindly write to me if any such occurrence of Common carp has been observed or reported to them.

DISTRICT FISHERIES OFFICER,
P. O. KATRAIN 175 129,
DISTRICT KULU,
HIMACHAL PRADESH,
November 24, 1981.

S. B. RAIZADA

16. NEW RECORDS OF APHIDS (HOMOPTERA: APHIDIDAE) FROM SIKKIM, NORTH EAST INDIA

Raychaudhuri (1980) reported 404 aphid species under 155 genera from northeast India. Out of these Sikkim, the smallest state in the region, had 134 species under 71 genera. Further exploration of the state has revealed the occurrence of another 27 species under 26 genera reported here as new records from Sikkim.

As a result of this study the aphid fauna of Sikkim is now known to be 161 species under 84 genera. These include 24 endemic species. Specimens of the reported species are presently in the collection of Entomology Laboratory, Department of Zoology, University of Calcutta.

Subfamily Aphidinae

Tribe Aphidini

Aphis paraverbasci Chakrabarti

Aphis paraverbasci Chakrabarti, 1976. *Entomon* 1(2): 171-174.

Material examined: 4 apterae and 1 alata from an indet. plant, Lachung (*c.* 300 m), 6.vi.1975.

Distribution: INDIA: Himachal Pradesh, Sikkim.

Schizaphis graminum (Rondani)

Aphis graminum Rondani, 1852. *Nuova Ann. Sci. Nat. Bolonga* (Ser 3), 6: 10.

Material examined: 1 alata and 2 nymphs from an indet. grass, Singtam (*c.* 541 m), 24.xii.1970.

Distribution: Cosmopolitan.

Schizaphis rotundiventris (Signoret)

Schizaphis rotundiventris (Signoret): Eastop, 1966. *Aust. J. Zool.* 14: 498.

Material examined: 2 apterae and 2 nymphs from *Cyperus exhaltans*, Singtam (c. 541 m), 27.v.1970.

Distribution: INDIA: Meghalaya, Sikkim, South India, Uttar Pradesh, West Bengal; and virtually cosmopolitan.

Tribe Macrosiphini

Acyrthosiphon pisum (Harris)

Aphis pisum Harris, 1776. *Exposit. English Insects*, London, 66.

Material examined: Many apterae and nymphs from *Pisum sativum*, Namchi (*c.* 1666 m), 21.iv.1978.

Distribution: Cosmopolitan.

Brevicoryne brassicae (Linnaeus)

Aphis brassicae Linnaeus, 1758. *Systema Nature* 1 (10th ed.): 452.

Material examined: 1 aptera, 2 alatae and 2 nymphs from *Brassica* sp., Tsungthang (*c.* 1666 m), 9.vi.1975.

Distribution: INDIA: Himachal Pradesh, Sikkim, South India, West Bengal; and virtually cosmopolitan.

Cavariella nigra Basu

Cavariella nigra Basu, 1964. *J. Linn. Soc.* (*Zool*), 45: 240.

Material examined: 5 apterae, 21 alatae and 6 nymphs from an indet. plant, Lachung (*c.* 3000 m), 6.vi.1975.

Distribution: INDIA: Sikkim, West Bengal.

Capitophorus polygoni Ghosh, Ghosh and Raychaudhuri

Capitophorus polygoni Ghosh, Ghosh and Raychaudhuri, 1971. *Orient. Insects* 5: 326.

Material examined: 1 aptera and 1 nymph from *Polygonum* sp., Lachung (*c.* 3000 m), 10.vii. 1977.

Distribution: INDIA: Sikkim, West Bengal.

Indomegoura indica (van der Goot)

Rhopalosiphum indica van der Goot, 1916. *Rec. Indian Mus.* 12(1): 1-4.

Material examined: 1 alata from an indet. plant, Gangtok (*c.* 1675 m), 19.v.1975.

Distribution: INDIA: Sikkim, West Bengal.

Indumasonaphis inulae (Ghosh and Raychaudhuri)

Masonaphis (*Neomasonaphis*) *inulae* Ghosh and Raychaudhuri, 1972.

Orient. Insects 6: 377.

Material examined: 3 apterae and 22 nymphs from an indet. plant of Ericaceae, Phodang (*c.* 1900 m), 15.xi.1974.

Distribution: INDIA: Meghalaya, Sikkim.

Liosomaphis himalayensis Basu

Liosomaphis himalayensis Basu, 1964. *J. Linn. Soc.* (*Zool.*) *45*: 231.

Material examined: 4 apterae and 3 nymphs from *Berberis* sp., Lachung (*c.* 3000 m), 7.vi.1976.

Distribution: INDIA: Himachal Pradesh, Meghalaya, Sikkim, Uttar Pradesh, West Bengal.

Macromyzus (Anthracosiphoniella) maculatum (Basu)

Anthracosiphoniella maculatum Basu, 1969. *Orient. Insects* 3: 169.

Material examined: Many apterae and nymphs from indet. ferns, Mangan (*c.* 1500 m), 23.v.1975; Paksyak (*c.* 1666 m), 1.vi.1975.

Distribution: INDIA: Meghalaya, Sikkim and West Bengal.

Myzus brevisiphon Basu

Myzus brevisiphon Basu, 1969. *Orient. Insects* 3: 180.

Material examined: 5 apterae and 10 nymphs from *Polygonum alatum*, Tsungthang (*c.* 1666 m), 14.xi.1974.

Distribution: INDIA: Meghalaya, Sikkim, Uttar Pradesh, West Bengal.

Oedisiphum soureni Basu

Oedisiphum soureni Basu, 1964. *J. Linn. Soc.* (*Zool.*) 45: 238.

Material examined: 2 apterae and 3 nymphs from *Anaphalis* sp., Esungthang (*c.* 1666 m), 14.xi.1974.

Distribution: INDIA: Sikkim, Uttar Pradesh, West Bengal; Nepal.

Semiaphis heraclei (Takahashi)

Semiaphis heraclei (Takahashi): Takahashi, 1965. *Insecta matsum.* 28:53.

Material examined: 4 apterae, 2 alatae and 5 nymphs from *Schizium* sp., Paksyak (*c.* 1666 m), 4.vi.1975.

Distribution: INDIA: Meghalaya, Sikkim, West Bengal; China, Hawaii, Japan; Korea; Sumatra; Taiwan.

Micromyzus kalimpongensis Basu

Micromyzus kalimpongensis Basu, 1967. *Bull. Ent.* 8: 152.

Material examined: 21 apterae, 10 alatae and 15 nymphs from *Elettaria cardamomum*, Ringon (*c.* 1600 m), 9.xi.74.

Distribution: INDIA: Meghalaya, Sikkim, West Bengal.

Trichisiphonaphis gerberae Ghosh and Raychaudhuri

Trichisiphonaphis gerberae Ghosh and Raychaudhuri, 1972. *Orient. Insects* 6: 381.

Material examined: 4 apterae and 12 nymphs from *Polygonum* sp., Gangtok (*c.* 1675 m), 15.xi.1974.

Distribution: INDIA: Meghalaya, Sikkim, West Bengal.

Vesiculaphis pieridis Basu

Vesiculaphis pieridis Basu, 1964. *J. Linn. Soc.* (*Zool.*) 45: 237.

Material examined: 19 apterae and 8 nymphs from *Pieris ovalifolia*, Lachung (*c.* 3000 m), 6.vi.1975.

Distribution: INDIA: Meghalaya, Sikkim. Uttar Pradesh, West Bengal.

Subfamily GREENIDEINAE
Tribe CERVAPHIDINI

Sumatraphis celti Takahashi

Sumatraphis celti Takahashi, 1935. *Misc. Zool. Summatrana* 97: 3.

Material examined: 35 apterae and 15 nymphs from *Quercus* sp., Lingdong (*c.* 1666 m), 24.v.1975.

Distribution: INDIA: Meghalaya, Sikkim, South India, West Bengal; Indonesia.

Tribe GREENIDEINI

Eutrichosiphum arunachali Basu, Ghosh and Raychaudhari

Eutrichisiphum arunachali Basu, Ghosh and Raychaudhuri, 1972. *Sci. Cult.* 38: 494.

Material examined: 35 apterae, 6 alatae and 4 nymphs from *Quercus* sp. Gangtok (*c.* 1666 m), 22.iv.1975.

Distribution: INDIA: Arunachal Pradesh, Sikkim.

Eutrichosiphum takahashii Basu, Ghosh and Raychaudhuri

Eutrichosiphum takahashii Basu, Ghosh and Raychaudhuri, 1973. *Proc. zool. Soc., Calcutta* 26: 95.

Material examined: 13 apterae and many nymphs from *Quercus* sp., Dongu Lik (*c.* 1166 m), 6.xi.1974.

Distribution: INDIA: Meghalaya, Sikkim.

Greenideoida (Pentatrichosiphum) luteum (Basu)

Pentatrichosiphum luteum Basu, 1969. *Orient. Insects* 3: 183.

Material examined: 3 apterae, 4 alatae and 2 nymphs from *Quercus* sp., Deorali (*c.* 1670 m), 16.xi.1974.

Distribution: INDIA: Meghalaya, Sikkim and West Bengal.

Mollitrichosiphum shinjii Raychaudhuri, Ghosh, Banerjee and Ghosh

Mollitrichosiphum shinji Raychaudhuri *et al.* 1973. *Kontyu* 41: 70.

Material examined: 8 apterae and 11 nymphs from *Quercus rubra*, Sanklang (*c.* 1000 m), 3.xi.1974.

Distribution: INDIA: Sikkim, West Bengal.

Subfamily: HORMAPHIDINAE

Aleurodaphis blumeae van der Goot

Aleurodaphis blumeae van der Goot, 1917. *Contrib. Faune Ind. neerl.* 1: 240.

Material examined: 14 apterae and many nymphs from an indet. plant of Combretaceae, Sanklang (*c.* 1000 m), 3.xi.1974.

Distribution: INDIA: Arunachal Pradesh, Meghalaya, Sikkim, West Bengal; China; Indonesia; Japan; Korea; Taiwan.

Ceratovacuna indica Ghosh, Pal and Raychaudhuri

Ceratovacuna indica Ghosh, Pal and Raychaudhuri, 1974. *Proc. zool. Soc., Calcutta* 27: 96.

Material examined: 17 apterae and many nymphs from an indet. bamboo plant, Ringon (*c.* 1600 m), 26.v.1975.

Distribution: INDIA: Sikkim, West Bengal.

Subfamily LACHNINAE
Tribe CINARINI

Cinara atrotibialis David and Rajasingh

Cinara atrotibialis David and Rajasingh, 1968. *Orient. Insects* 2: 103.

Material examined: 6 apterae and many nymphs from *Pinus* sp., Namchi (*c.* 1666 m), 22.x.1975.

Distribution: INDIA: Himachal Pradesh, Meghalaya, Sikkim; Thailand; Phillipines.

Tribe LACHNINI

Nippolachnus piri Matsumura

Nippolachnus piri Matsumura, 1917. *T. Coll. Agric. Taihoku Imp.* 7: 382.

Material examined: 4 apterae and 16 nymphs from *Pyrus communis*, Pelling (*c.* 2080 m), 15.x.1974.

Distribution: INDIA: Meghalaya, Sikkim, West Bengal; Bhutan; Japan; Korea; Taiwan.

Subfamily PEMPHIGINAE

Asiphoniella cynodonti (Das)

Pemphigus cynodonti Das, 1918. *Mem. Ind. Mus.* 6: 153.

Material examined: 4 apterae and 16 nymphs from *Abies* sp., Lachung (*c.* 3000 m), 14.v.1978.

Distribution: INDIA: Sikkim, West Bengal; Pakistan.

ACKNOWLEDGEMENTS

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December 4, 1981.

REFERENCE

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* Deceased 1st May, 1981.

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17. FIRST RECORD OF *DIPLACODES LEFEBVREI* (RAMBUR) (ODONATA: LIBELLULIDAE: SYMPETRINAE) FROM NW. INDIA

While working on the un-named Odonata collections of this Regional Station, I came across some specimens which on examination proved to be *Diplacodes lefebvrei* (Rambur). These agree practically in all characters with Fraser's description (1936) of the species. In India, the species has hitherto been known only from the west coast (Fraserpet, Coorg) and is now being recorded for the first time from Rajasthan and Gujarat, thus extending its range further westwards.

Material examined:

Gujarat: 2 ♂♂ Khari river, Bhuj, 22.10.1964, coll. B. C. Agrawal. Rajasthan: 1 ♂ Kailana, Jodhpur, 24.4.1962, coll. Survey party, Desert Regional Station; 2 ♂♂ Akhairaj ji ka talab, Jodhpur, 17.9.1963, coll. Moti Lal; 1 ♂ Kuri village, Jodhpur, 25.5.1964, coll. V. C. Agarwal; 1 ♂ Agolai, Jodhpur, 18.9.1964, coll. R. N. Bhargava, 1 ♂ Agolai, Jodhpur, 19.8.1965, coll. V. C. Agarwal; 3 ♂♂ 1 ♀ Bada talab, Pali, 3.11.1964, coll. T. G. Vazirani, 1 ♂ Hemawas Dam, Pali, 17.10.1978, coll. J. C. Tripathi.

Measurements:

MALE: Abdomen 19.00 mm., Forewing 23.00 mm., Hindwing 22.00 mm.
FEMALE: Abdomen 17.00 mm., Forewing 20.00 mm., Hindwing 20.00 mm.

ACKNOWLEDGEMENTS

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R. K. THAKUR

ZOOLOGICAL SURVEY OF INDIA,
DESERT REGIONAL STATION,
JODHPUR,
March 5, 1982.

REFERENCE

FRASER, F. C. (1936): Fauna of British India. Odonata, 3: Taylor and Francis, London. xi + 461.

18. A NOTE ON THE ODONATA (INSECTA) FROM SIKKIM, INDIA

(*With nine text-figures*)

Sikkim in the Himalayas has elevations varying between *c.* 350 metres and *c.* 9000 metres. Hill slopes are often covered with forests but patches of agricultural fields are also quite common. As a result of deforestation and other human activities a vast area is devoid of any vegetation, where only exposed rocks are visible. A total of 42 species of Odonata are reported from Sikkim by earlier workers i.e., Asahina (1952-53), Fraser (1933, 1934a, 1934b, 1935a, 1935b, 1935c, 1936a, 1936b, 1940a and 1940b), Kennedy (1936), Kiauta (1972 and 1975), Lahiri (1979), Laidlaw (1915, 1917a and 1971b) and St. Quentin (1970). This study is based on a small collection of Odonata, of these seven species and subspecies are reported for the first time from the area. Intraspecific variations of some species and subspecies studied are incorporated in the text.

Family: EUPHAEIDAE

1. **Bayadera indica** Selys

Material: 1 ♀, Fatak near Mangan, 12.4.81; 2 ♂♂, Khanikhola, 6.7.79 and 2 ♂♂ Rangpo, 7.4.1981.

Distribution: Western Himalayas, Meghalaya and Nepal.

Remarks: A small minute spine also present on the superior anal appendages, cubital nervures 1-2 in number, 25 antenodal and 23 postnodal nervures present in forewings and 21 antenodal and 22 postnodal nervures in hindwings.

Family: GOMPHIDAE

2. **Mesogomphus lineatus** Selys

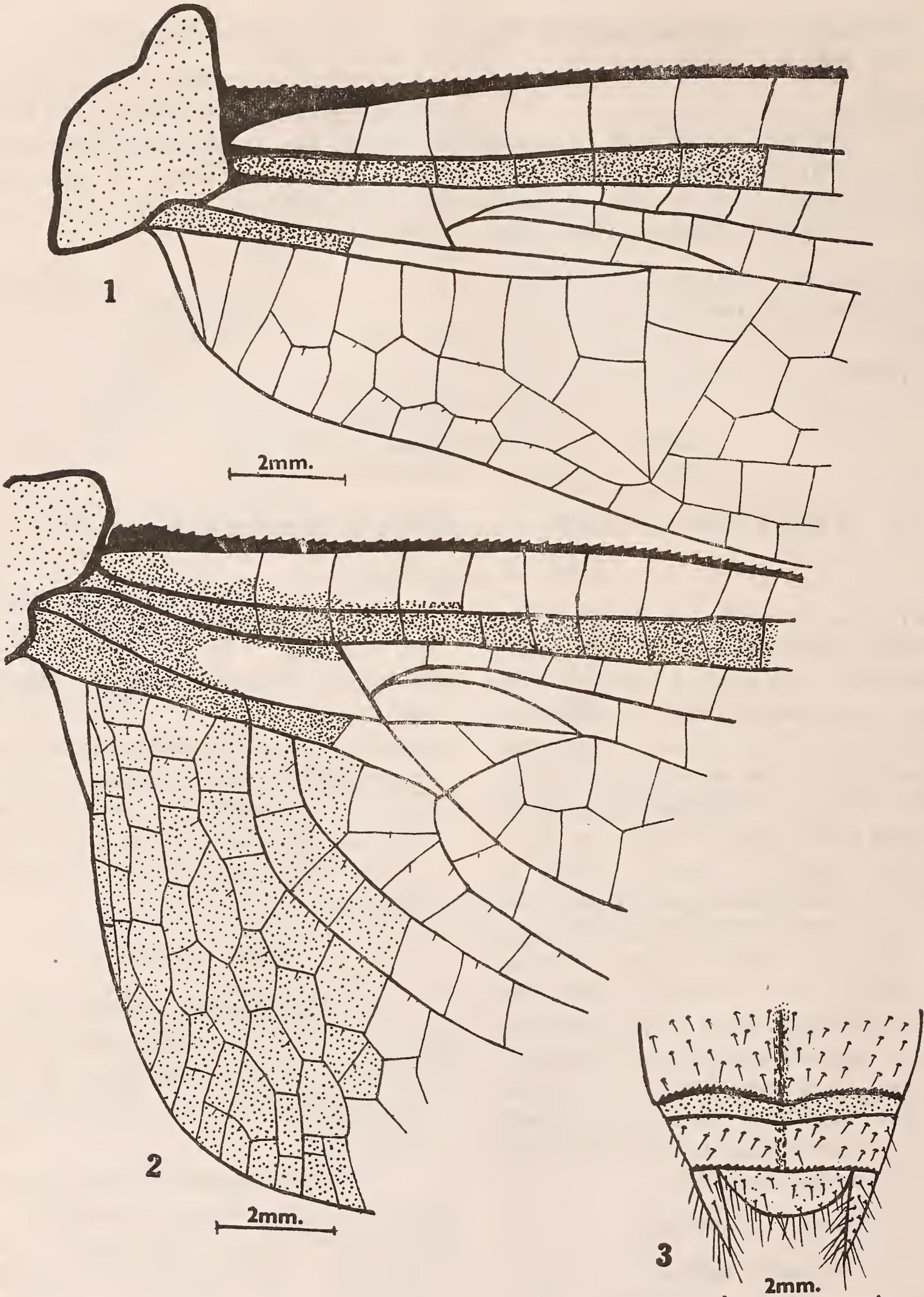
Material: 1 ♂, 1 ♀, Khanikhola, 6.7.79.

Distribution: Western Himalayas, W. Bengal, Maharashtra, Karnataka, Tamil Nadu, Nepal and Burma.

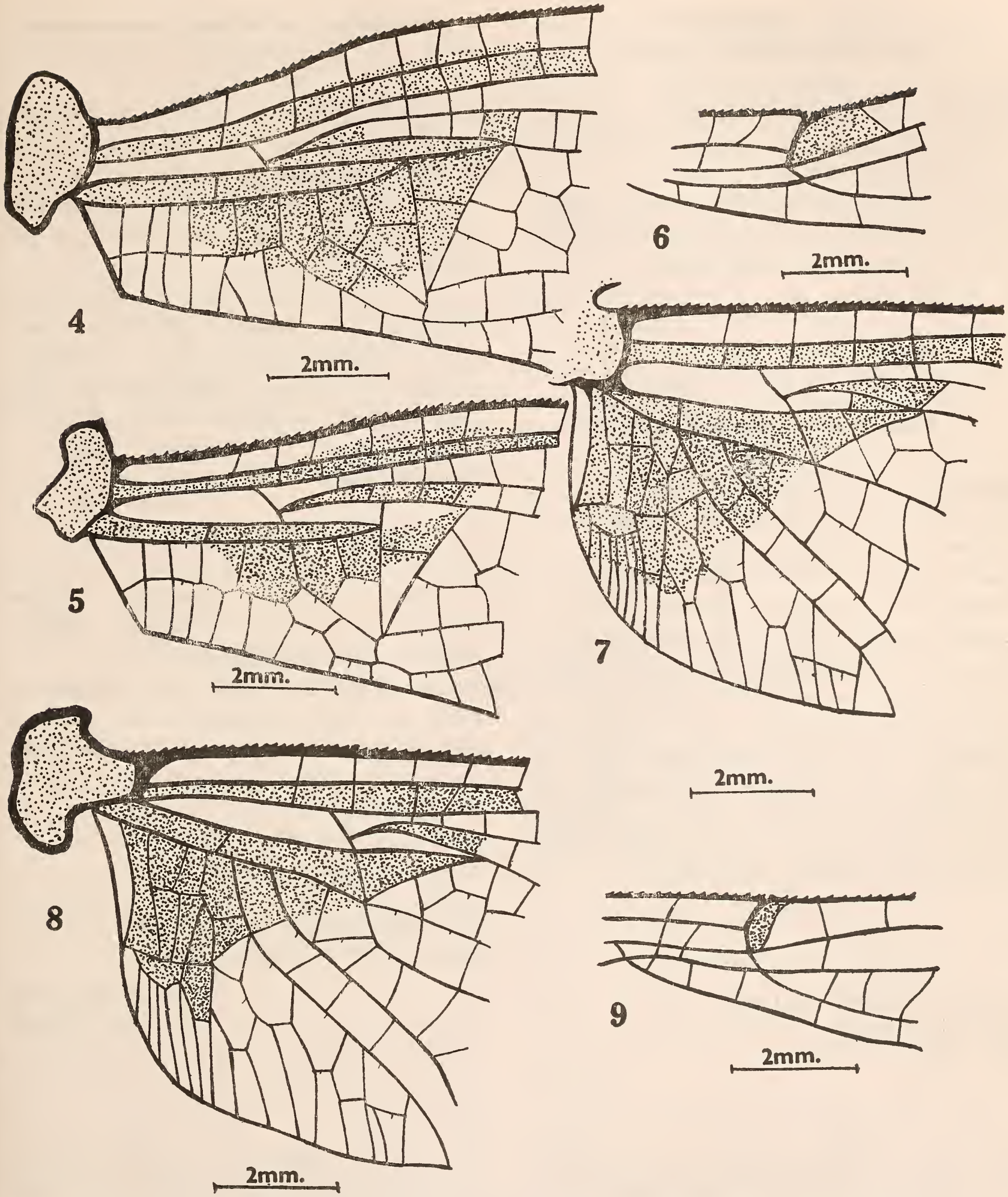
3. **Nepogomphus modestus** Selys

Material: 2 ♂♂, Rangpo, 4.7.1979.

Distribution: Western Himalayas, W. Bengal, Meghalaya. Nagaland, Burma, Malaysia and Sumatra.



Figs. 1-3. Female of *Lyriathemis bivittata* (Rambur). 1. Brown stripe markings in forewing, 2. Brown stripe markings in hind wing, 3. Dorsal view of anal appendages.



Figs. 4-9. Variations in the markings of black stripe in both fore and hindwings of the male specimens of *Palpopleura s. sexmaculata* (Fabricius) (4-6 showing variations in the black stripe markings in forewings, (7-9 showing variations in the black stripe markings in hindwing).

Family: AESHNIDAE

4. **Anax immaculifrons** Rambur

Material: 1 ♀, Rangpo, 6.4.1981.

Distribution: Western Himalayas, Pakistan, British Isles across to Europe, Central Asia and North Morocco.

Remarks: Specimen attracted towards electric light. 6 cubital nervures present in forewings and 4 in hindwings, nodal index —

11–18 | 20–10
—+—
12–12 | 13–11

Family: LIBELLULIDAE

5. **Lyriathemis biyittata** (Rambur)
(Figs. 1-3)

Material: 1 ♀, Khanikhola, 6.7.79.

Distribution: Darjeeling, Assam, Burma, Indo-China and Thailand.

Remarks: Brown stripe in the forewings extends upto 6 nervures in subcosta, whole of cubital nervure (Fig. 1); in hindwing it extends upto 3rd antenodal nervures in costa, 7 antenodals in subcosta, hypertrigone, 2 cells in cubital nervures; brown marking also present on the base of hindwings (Fig. 2); 1 cubital nervure present in forewings and 2 in hindwings; discoidal cell traversed only once in right forewings and hindwings; while twice in left forewing. Nodal index —

9– | 17–10
—+—
11–14 | 13–10

6. **Palpopleura sexmaculata sexmaculata** (Fabr.)
(Figs. 4-9)

Material: 1 ♀, Martam, 16.7.79; 1 ♂, Paglakhola, 19.7.79 and 2 ♂♂, Rangay, 12.7.79.

Distribution: Western Himalayas, W. Bengal, Assam, Bihar, Tamil Nadu, Karnataka, Andhra Pradesh, Malaysia, Indo-China and China.

Remarks: Black stripe present in both fore and hindwings quite variable, even in the specimens collected on same day from Rangay (Figs. 4-9). Discoidal cells traversed only once in right forewing while twice in left forewing, nodal index —

5–11½ | 10½–5
—+—
6–8 | 8–6

7. **Diplacodes nebulosa** (Fabricius)

Material: 1 ♂, Duga, 5.7.79.

Distribution: Western Himalayas, Madhya Pradesh, W. Bengal, Penang, Malaya, Sumatra, Java and Australia.

Remarks: Only one cubital nervure present in both the wings, subtrigone entire, discoidal field begins with two rows of cells, nodal Index—

6–7½ | 7½–5
—+—
5–6 | 6–5

ACKNOWLEDGEMENT

We thank the Director Zoological Survey of India, Calcutta for various facilities.

ZOOLOGICAL SURVEY OF INDIA,
CALCUTTA - 700 072,
July 1, 1982.

M. PRASAD
S. K. GHOSH

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19. NIGER GRAIN FLY, *DIOZINA SORORCULA* (WIEDEMANN), A SERIOUS PEST OF NIGER IN CENTRAL INDIA

Narayanan (1961) and Rai (1977) listed the insect pests infesting niger [*Guizotta abyssinica* (Linn. f.) Cass] in India, important among which are the safflower caterpillar, *Prospalta* (*Perigea*) *capensis* (Guen.); aphid, *Uroleucon compositae* (Theobold), semilooper, *Plusia orichalcea* (Fab.); surface grasshopper, *Chrotogonus* sp. and curculionid beetle, *Lixus brachyrrhinus* Boh.

During the survey of insect pests of niger at Jabalpur, the grain fly, *Diozina sororcula* (Wiedemann) (Diptera: Taphretidae) was observed for the first time on niger, infesting developing grains in the seed capsule. The female fly lays eggs in the inflorescence in between the disc florets. The eggs are creamy white in colour tapering at one end and measure 0.81 mm in length and 0.16 mm in width. The incubation period lasts for 24 to 72 hours. The freshly hatched maggots bore into the developing seeds and feed on its contents without disturbing the testa and the seed coat of the seed. The maggot completes its life-cycle in a single seed and does not destroy the neighbouring grains. The infested seed does not show any external sign of infestation until the fly emerges out from the seed. Hence, though a high population of the fly exists in the field, it becomes difficult to detect the infestation.

The full grown larva measures 2.2 mm in length and 1.0 mm in width. The larval period lasts for 7 to 12 days. Pupation takes place inside the seed coat. The pupal period lasts for 8 to 15 days. The pupa measures 2.0 mm in length and 1.1 mm in width.

The insect remains active from July to December if the niger crop is available in the field. It remains most active from September to November, when the crop of normal sowing season remains in flowering stage and 15 to 20 per cent seeds were found to be damaged by the fly. Being a direct pest infesting grains which are ultimately utilized, it seems to be more destructive than *P. capensis* and *U. compositae* which are indirect pests of niger.

I am thankful to the Director, Commonwealth Institute of Entomology, London for the identification of the pest.

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20. OVIPOSITION OF TWO CHIRONOMIDS (DIPTERA) IN THE LABORATORY

The oviposition of chironomid midges is little known in comparison to the other aspects of biology studied in the laboratory (Oliver 1971). There is no record on the oviposition of chironomids in India and less attention has been paid to the biological aspects and oviposition in particular. The present study is aimed at clarifying oviposition in two Indian chironomids, *Chironomus barbatitarsis* Kieffer and *C. filitarsis* Kieffer in the laboratory. This study provides some information on the mechanism of oviposition and its behaviour during oviposition.

A stock colony of the insects was maintained in the laboratory for study. The gravid females were allowed to lay eggs in encaged culture trays — Petridishes containing tap water having 2-3 floating paper strips. As soon as the larvae emerged, they were transferred to another cage of similar nature containing water on a bed of sterilised mud and thin layer of fine sand. The larvae were fed with ground rabbit chow, filamentous algae. A little amount of Bakers' yeast was also used for food. This was repeated for obtaining the stock culture.

The chironomids laid eggs in masses and the number of egg masses was one to many. The egg masses were cylindrical and the number of which was one but often a second, though small, was found to be deposited by the females of *Chironomus barbatitarsis*. However, in both the species the egg masses were provided with suspensory stalk and anchoring chord. The number of eggs within an egg mass varied from 400 to 500 in *C. barbatitarsis* and 150 to 250 in *C. filitarsis.* The eggs in the masses were oriented in a spiral fashion in the former and in 5-6 longitudinal rows in the latter species. The ovipostional behaviour was studied in the following three phases and both the species showed more or less similar pattern of behaviour.

Preovipositional behaviour — As soon as the females were released in the cages in the laboratory, they were seen to perform a very short flight after which some of them took their position on the wall of the cage. About 40% of the females rested on the floor of the cage while others were seen to wander inside the cages. The petridishes/pots in the culture were provided with water having some floating paper strips. The insects remained as such for 20-50 minutes after which most of them approached the petridishes and the others remained on the wall and floor of the cage where some of them ultimately died. The chironomids near the culture pots were seen to move a little for about 10-20 minutes and then rested on the floating strips of paper or at the edges of the dishes or over the water surface. Some individuals were noticed to return to the net or the floor of the cage without laying the eggs. These females died after 2-3 days which were recorded to be their life span.

Behaviour during oviposition: At the onset of oviposition the genitalia was placed over water and the hind legs were set apart. Immediately before release of eggs the insects moved a few steps forward so that the egg mass remained attached to the floating papers. The individuals remaining near or at the edges of the pots also placed their genitalia just on the upper water level and laid their egg masses approximately 0.5 mm above the water surface. A few females floating over the water deposited the egg masses there in water and little movements of legs and antennae were observed.

Postovipositional behaviour: As soon as the oviposition was completed most of the females returned to the wall or floor of the cage within 2-3 minutes after oviposition. Some of them remained quiet and a few were often seen to perform little flight in captivity. As such the chironomids lived for 2-3 days (*C. barbatitarsis*) and 1-2 days (*C. filitarsis*) after which the insects died. Vigorous movements of the chironomids were noticed before death of the individual. The remaining females which were still on the paper strips even after egg deposition also remained quiet or sometimes showed short leaping movements over the sites. Finally, they died on the water surface with the eggs carried on the legs. These insects were found to last for 2-10 hours only. The insects with the egg masses stuck to the body were seen to sink in the water.

As reported by Macan (1961) the selective oviposition behaviour occurred in a number of aquatic insects and the present *Chironomus* spp. were not an exception. According to Curry (1956), Dyson & Lloyd (1936) and Fryer (1959) chironomids preferred floating objects for egg deposition which did agree with our observations made during this study. In addition to those, it was noticed that the laying of eggs also took place over the water without any object and at the edge of the water. The species of *Chironomus* oviposited in between 18-23 hours and they exhibited dial periodicity in respect to egg laying. The time of oviposition was therefore marked from the evening to midnight and sometimes also in the dawn and at dusk.

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21. LIFE HISTORY, EPHIPPIA DEVELOPMENT, CYCLOMORPHOSIS AND TEMPERATURE EFFECT ON LIFE CYCLE IN *DAPHNIA LUMHOLTZI* SARS (CLADOCERA: DAPHNIDAE)

(*With two plates & a text-figure*)

INTRODUCTION

Fish production in aquatic ecosystem depends largely upon the secondary link in the aquatic food chain, which constitutes important fish food organisms. Cladocerans are the main components of this phase of organic production which have nutritional values for the growth and production of fish. Although the importance of Cladocera as fish food, both for fry and adults, has been stressed by different workers (Alikunhi 1952, Pennak 1953, Hutchinson 1967, Kanaujia 1979), only scanty information is available on their seasonal abundance, life-cycle, cyclomorphosis and sexual reproduction in natural freshwater environment in tropical regions. In India, Michael (1962), Murugan (1973, 1975), Murugan & Sivaramakrishnan (1975, 1976), Navaneethakrishnan & Michael (1971), and Kanaujia (MS) have studied the life cycle, biology and seasonal abundance of various species of Cladocera. Observations made on the life-cycle, including effect of seasonal temperature, ephippial development and cyclomorphosis in *Daphnia lumholtzi* under laboratory and field conditions, and results obtained are presented in this paper.

MATERIAL AND METHOD

Daphnia lumholtzi collected from a fish pond at Cuttack, India (Long. 85°52′E, Lat. 20° 29′N) was used for the study. An egg-bearing female was reared separately in 1-litre beaker with the same pond water. Newly released young ones were reared individually in 20 beakers of 100 ml capacity filled with pond water filtered through No. 25 Nylobolt silk cloth. The filtered pond water contained minute nannoplankters. (*Chlorella* sp., *Scenedesmus* sp. and *Tetraspora* sp.) besides detritus, which served as food for the reared specimens. Water in the beakers was changed once every 24 hours. Observations were recorded on duration of each instar, length increment at each instar, total number of instars, number of young ones in each brood, total life span and water temperature.

For the study of different stages of embryonic development a hundred egg-bearing females were reared in a 10-litre glass jar. The developing embryo was dissected out of the brood sac and various stages were photomicrographed.

Another set of experiments was conducted to study the influence of temperature on the life cycle.

Some possible studies were made on Cyclomorphosis and ephippial development through culturing the specimens in 10-litre glass jars filled with tap water and fed with cowdung solution (500 and 1000 ppm) and others with pond water.

Observations

D. lumholtzi thrive well on fine organic detritus as well as phytogroup of nannoplankton (*Scenedesmus* sp., *Chlorella* sp. and *Tetraspora* sp.) available in the pond. Their multiplication continued with the availability of required food. After a few days the density declined gradually and the pond water became

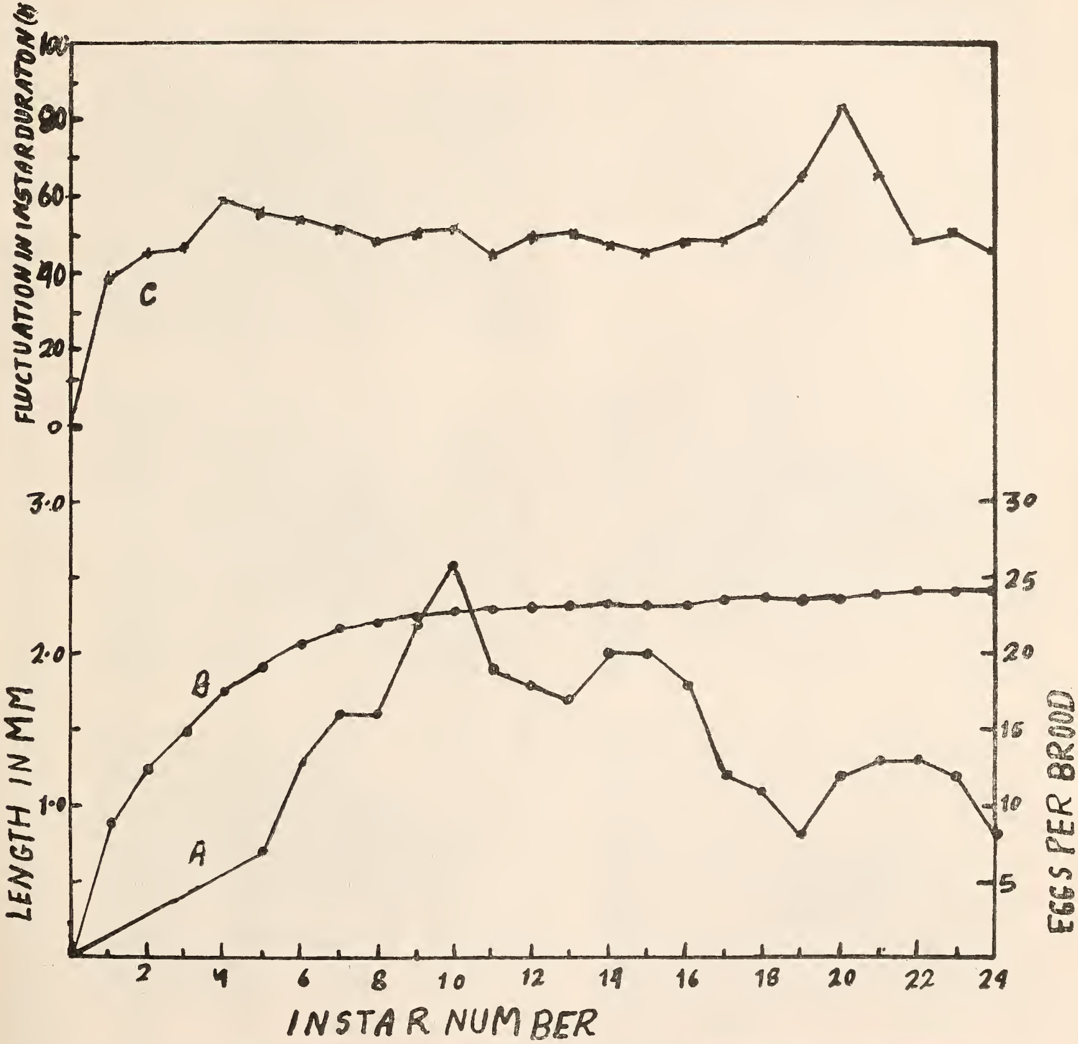


Fig. 1. (A) Instar number and eggs per brood, (B) Progressive growth increment at each instar, and (C) Fluctuation in instar duration in *Daphnia lumholtzi* at 18°-26°C.

clear from its original greenish colour. The same was observed in glass jars with tap water, cowdung solution and also water media containing *Tetraspora.*

Cyclomorphosis:

The specimens collected from the pond water at 16°-20°C water temperature had long anterior rostrum (0.73 mm) and posterior tail spine (0.76 mm) during December-February. When the same specimens were reared in jars, the rostral spine in most of the specimens atrophied and disappeared. In the newly hatched young reared in 100 ml beaker for the study of life-cycle the rostrum also got reduced after a few instars.

Life history:

The female laid eggs inside the brood pouch. Just after the last pre-adult instar, the newly released eggs assumed round shape. Subsequent development passed through eight embryonic stages as described by Green (1965) in the case of *Daphnia magna.* Liberation of young apparently preceded every moulting.

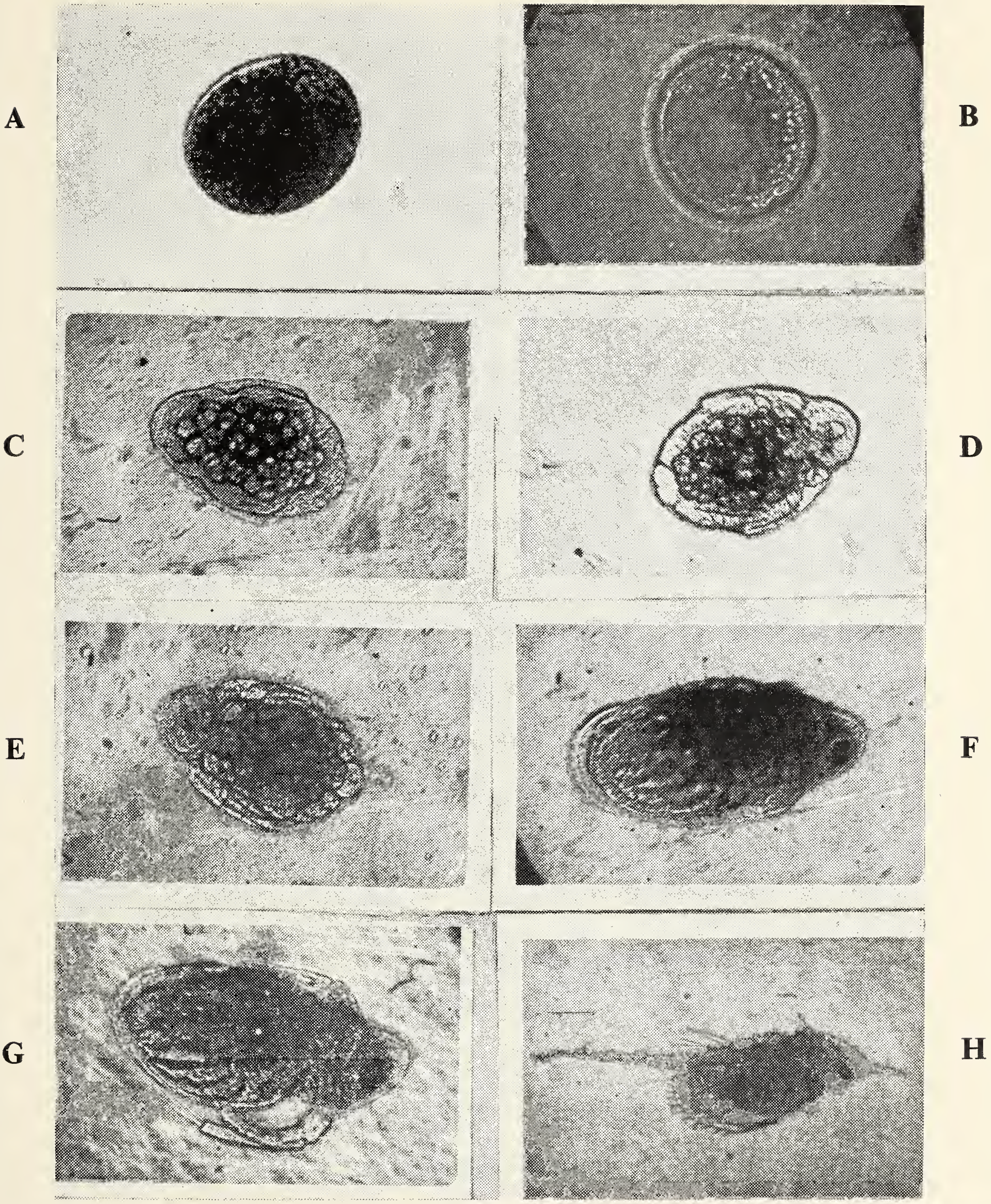
Various stages in the embryonic development of *D. lumholtzi* are as follows :

1. *Early stage*:
   - a) *Early*: The egg spherical with translucent peripheral zone of green granulated cells (Plate I-A).
   - b) *Late*: Central region of the egg shows yellow fat cells. Both the outer egg membrane as well as inner naupliar membrane (Plate I-B).
2. *Middle stage*:
   - a) *Early*: Embryo well elongated antero-posteriorly surrounded by egg membrane (Plate I-C, D).
3. *Late stage*:
   - a) *Early*: Distinct dark eyes formed; the cervical depression conspicuous (Plate I-E, F).
   - b) *Late*: Embryos reach maximum length; paired eyes overlapping each other and finally fused; development of alimentary canal com-

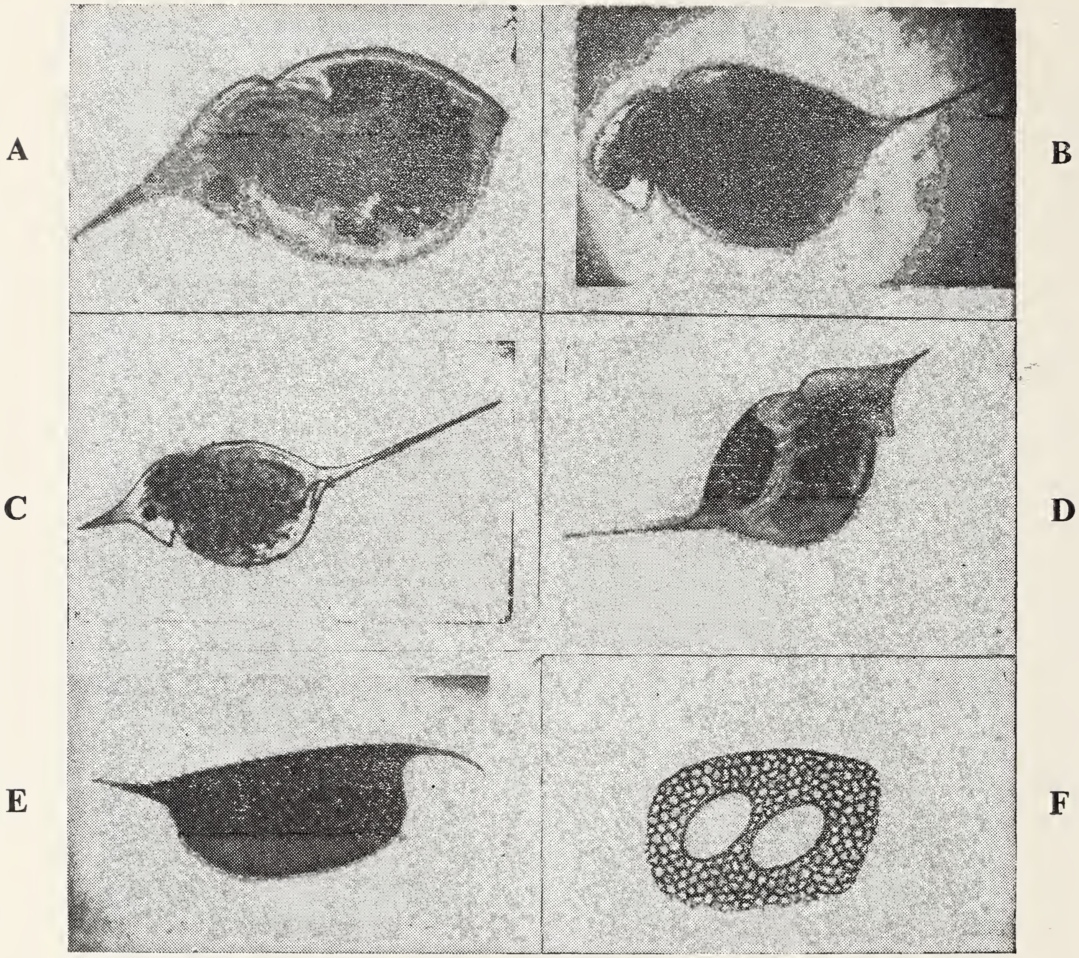
TABLE 1

MEAN LENGTH, NUMBER OF EGGS/BROOD, DURATION OF EACH INSTAR IN HOURS, CUMULATIVE DURATION OF EACH INSTAR IN HOURS AND CUMULATIVE FREQUENCY OF EGGS IN EACH INSTAR IN *D. lumholtzi* AT 18°-26°C.

Instar number	Mean length mm	Number of eggs produced	Total number of eggs produced	Duration of each instar (h)	Cumulative duration of each instar (h)
1	0.90	—	—	39	39
2	1.25	—	—	45	84
3	1.33	—	—	47	131
4	1.78	—	—	54	185
5	1.93	7	7	60	245
6	2.09	13	20	55	300
7	2.18	16	36	52	352
8	2.21	16	52	48	400
9	2.24	22	74	50	450
10	2.27	26	100	51	501
11	2.29	19	119	44	545
12	2.30	18	137	49	594
13	2.31	17	154	50	644
14	2.33	20	174	47	691
15	2.33	20	194	45	736
16	2.34	18	212	48	784
17	2.35	12	224	48	832
18	2.37	11	235	53	885
19	2.38	8	243	66	951
20	2.39	12	255	83	1034
21	2.40	13	268	65	1099
22	2.41	13	281	48	1147
23	2.41	12	293	50	1197
24	2.41	8	301	46	1243



A. Spherical egg with granulated cells (0.19 mm).
B. Spherical egg with the central circular area surrounded by granular cells (0.19 mm).
C. Elongated embryo with head rudiment, cleaved cells extending into the cephalic region (0.24 mm).
D. Embryo with head lobe and antennae (0.26 mm).
E. Elongated embryo with distinct head and limbs (0.76 mm).
F. & G. Late stage embryo with dark eyes and cervical depression (0.28 mm).
H. Newly hatched young one (0.76 mm).



A. Parthenogenetic female with eggs inside brood chamber and long rostrum but without tail spine — from pond water (2.61 mm).
B. Female with ephippia development, without rostrum from jar (0.94 mm).
C. Female with long rostrum and tail spine — from pond (2.28 mm).
D. Female with completely developed ephippia and long rostrum — from pond (2.44 mm).
E. Ephippium after moulting (1.15 mm).
F. Ephippial eggs with secondary inner membrane (hand sketch) (0.71 mm).

TABLE 2

COMPARATIVE DATA ON LIFE CYCLE OF 6 SPECIES OF CLADOCERA

Name of the species	*Daphnia lumholtzi*		*Cariodaphnia cornuta*		*Simocephalus acutirostratus*	*Daphnia carinata*	*Moina micrura*	*Scapholeberis kingi*
Temperature range	18°-26°C	24°-28°C	16°-25°C	18°-31°C	28°-30°C	28°-31°C	28°-30°C	28°-30°C
Number of pre-adult instars	4	3	2	2	4	5	2	2
Number of adult instars	20	18	17	25	18	8	11	17
Average eggs per brood	15.05	10.44	10.1	6.2	13.7	17.8	5.6	14.8
Range of eggs per brood	7–26	5–23	1–18	1–13	9–27	4–35	3–8	4–21
Total eggs produced	301	188	172.5	150.9	248	142.4	62.2	239.4
Average instar duration (h)	51.79	48.47	53.75	27.55	48.63	44.3	24	26.47
Range of instar duration (h)	39–83	24–76	37–71	20–34	27–72	–	24	24–38
Average duration of embryonic development (h)	52.51	50.38	53.75	29.83	46	40.8	24	24.0
Mean length (mm)	2.41	2.41	0.76	0.76	3.20	3.80	1.008	0.92
Cumulative duration of total instar (h)	1243	1018	1109.4	746	1071	576	312	493.6
Total life span (days)	54	44	46	31	44	24	13	20.5

pleted; appendages distinct; elongated pointed rostrum clearly seen (Plate I-F, G).

After complete development, the embryo hatches out from brood chamber resembling the adult in all respects (Plate I-H). The anterior rostrum in the newly hatched young one measured 0.19 mm and the characteristic tail spine 0.57 mm. The young one measured 0.76 mm excluding the two spines and reached adult stage after passing 3-4 pre-adult instar.

Ephippial development:

Ephippium in *D. lumholtzi* is observed in crowded populations after parthenogenetic breeding slows down. The postero-dorsal carapace becomes modified into a specially thick dark envelope in which the resting eggs lie and these become distinct from the rest of the exuvium to form the ephippium (Plate II-B, D, E). Its development starts with a small transparent patch which — increases in size, forming a honeycombed structure (Plate II-B). A pair of dark green elongated eggs could be seen clearly (Plate II-F).

After release of a pair of eggs by the female, a male *D. lumholtzi* which is smaller in size, was observed to get attached to the female, with its posterior part of the body. The honeycomb-shaped ephippium assumed white transparency initially and then turned brown to black (Plate II-E). It gets thickened and the eggs were completely enclosed. The ephippium had two coverings in which the resting fertilized eggs lay — the outer one thick and black and the inner a translucent and thin membrane which could be taken out along with the paired eggs by gently pressing the ephippium (Plate II-F).

Effect of temperature:

Temperature was found to influence life cycle of *D. lumholtzi*. The instar duration (51.79 hrs), total number of eggs produced (301), average number of eggs per brood (15.05) and total life span (54 days) were found to be more at 18°-26°C as compared to the 24°-28°C (Table 2).

DISCUSSION

Present study of life cycle of *D. lumholtzi* indicates that the animal passes through an average of 3-4 pre-adult instars, 20 adult instars and a total of 301 eggs are produced in a life span of 54 days at a water temperature of 18°-26°C which has shown close similarity with other daphnids (Table 2). Studies on pre-adult instars have been made by Michael (1962), Murugan (1975), and Murugan & Sivaramakrishnan (1976) in species which have two pre-adult instars and others with more than two pre-adult instars (Murugan & Sivaramakrishnan 1973, Navaneethakrishnan & Michael 1971, Anderson 1932, Anderson *et al.* 1937 and Anderson & Jenkins 1942). *D. lumholtzi* falls under the second group. It may appear that the smaller species which have two pre-adult instars mature earlier than the larger species, *C. cornuta, M. micrura* and *S. kingi* (Table 2).

D. lumholtzi has close similarity with other cladocerans — where the first adult instar has longer instar duration (63 hours) during which the females are premiparous, and duration of this adult instar is distinctly longer than the longest pre-adult instar (52 hours) (Table 1). However, this phenomenon was found almost to be different from the observations of Murugan & Sivaramakrishnan (1976) and Murugan (1975) where both the instars have similar duration (Table 2).

The progressive increase in size of the individuals at each instar was found to be rapid during pre-adult phase and gradual in the reproductive phase, indicating similar growth behaviour as studied in other cladocerans. However, Green (1956) reported that in many cladocerans the maximum growth was in early pre-adult instars. The rate of growth per instar is said to be correlated with the food supply (Hutchinson 1967).

The ephippial eggs in *D. lumholtzi* appear with crowding; specimens were observed with ephippium along with the parthenogenetic females with few eggs inside brood chamber. Lack of food indicated by the clarity of water appears to result in sexual reproduction. It is interesting to note that when the ephippial female was removed from a crowded population and kept in a beaker with sufficient food the ephippium was cast out along with the moult and the same female started developing eggs parthenogenetically. Pennak (1953), Banta & Wood (1939), Berg (1931), Brandt & Fernando (1971), Santharam *et al.* (1977) and Michael (1962) have reported that the ephippial development is influenced by the crowding of the mothers in a small amount of culture medium or by chilling the culture medium.

Cyclomorphosis is the seasonal polymorphism exhibited by successive generations of planktonic organisms throughout a year. *D. lumholtzi* indicated its prominent seasonal variations particularly in helmet. The long rostral spine (Plate II-A, C, D) while present in pond water conditions was absent in jars containing tap water with cowdung solution, thereby indicating the influence of environmental divergent conditions on cyclomorphosis. Several investigators have given different views on the particular phenomena and the factors responsible for cyclomorphosis in *Daphnia* sp. have been discussed in detail by Hutchinson (1967), according to whom the change in environmental conditions, such as temperature and food supply, are the main factors. However, no major change is observed in the posterior tail spine of *D. lumholtzi.*

Present study indicated that the seasonal water temperature influence instar duration, number of eggs per brood, egg production and longevity of animal. Water temperature and food availability are the main factors for increasing the egg production, life span and instar duration as reported by MacArthur & Baillie (1929), Hall (1962), and Kanaujia (MS) in *D. magna, D. galeata mendotae* and *C. cornuta.*

It is well known that the food of cladocerans consists mainly of algae, protozoa and organic detritus suspended in water column and even bacteria (Pennak 1953, Hutchinson 1967). The higher density of *D. lumholtzi* has been recorded in ponds having the phyto-group of nannoplankters such as *Scenedesmus, Chlorella, Tetraspora* and organic detritus, indicating their suitability as food for the rapid growth and multiplication.

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22. A NOTE ON THE SETTLEMENT OF FOULING ORGANISMS ON FIBRE-GLASS BOATS

Copper and aluminium alloy sheathing of wooden boats below waterline are well known conventional method for protecting it against marine wood-borers and foulers, although it has been reported (Santhakumaran and Pillai 1976) that fouling organisms are capable of attachment to the toxic substratum provided even by Copper. Of late, fibre-glass has been used as a good constructional material for boat-building, because of its special qualities like toughness, rigidity, resistance to abrasion and marine borers and imperviousness to sea water. Although settling behaviour of fouling organisms on wooden materials as well as on various protective coatings has been studied by several workers, experimental work on the same on fibre-glass surface is very scanty. It has been observed that all the wooden panels, sheathed with fibre-glass, were free from the attack of marine borers, even after one year of continuous immersion at Cochin harbour, although they were covered by fouling organisms in the same way as any unsheathed controls (Balasubramanyan 1971). The only other available literature in India on the settlement of foulers on fibre-glass is that of Dehadrai *et al.* (1975), who gave an account of the incidence of foulers on fibre-glass-coated hull of a boat operated in an estuarine environment. The present note deals with the intense accumulation of barnacles on fibre-glass boats, belonging to the Central Institute of

Fisheries Education, Bombay, which were in operation in the Versova creek.

Of the two boats from which data were recorded, one, an 18 footer, was entirely constructed of fibre-glass. The other one, of 14 ft. size is a wooden boat, coated with 'Torpedo' marine antifouling paint and the bottom of which was sheathed at two places with fibre-glass mat, covering an area of about 4 sq. ft. each, using a polyster resin. The area to be covered was first scraped well till the wood is exposed and this surface was wetted with the activated resin over which a layer of fiber-glass mat was fixed and pressed with a hand brush. Over this, a second layer of mat was laid, spreading again with more quantity of resin. Finally, the area was covered with a finishing mat so as to give a smooth surface. The boats were in operation in the Versova creek for a period of only 9 months from September, 1974 to May, 1975. They were only sparingly used, for ferrying the fish catch, crew and other personnel from 'M. F. V. Harpodon', both in the morning and evening, and rest of the time they were anchored near main vessel. During the monsoon, they were removed to the C.I.F.E. Work-shop, offering a chance to study the fouling settlement on the hull of these boats.

The fouling intensity was very high. Surprisingly, among the foulers, only barnacles were noticed. Only *Balanus amphitrite* was observed and *Chthamalus withersi*, which is a very common species found settling in large numbers to the stems of living mangrove plants in this area was conspicuously absent on the hulls. Probably, the cementing mechanism of *Balanus*, with its well-formed calcareous basal plate is more efficient than that of *Chthamalus*, where the shell base is membraneous rendering it difficult to attach to the smooth fibre-glass surface. The intensity of the settlement on the fibre-glass boat and the fibre-glass mat surface is given in Table 1.

TABLE 1

NUMBER OF BARNACLES, PER SQUARE INCH, SETTLED ON FIBRE-GLASS BOAT AND FIBRE-GLASS MAT SHEATHED HULL.

Number of observations	Number of barnacles per sq. inch on Fibre-glass boat	 Fibre-glass mat
1	25	33
2	24	28
3	19	27
4	18	26
5	18	26
6	16	25

From Table 1, it can be seen that the intensity of settlement is as high as 25 per sq. in. (average 20 per sq. in.) and 33 per sq. in. (average 27.5 per sq. in.) on the fiber-glass boat and fibre-glass sheathed part of the wooden boat. The sheathing has also been found damaged and peeled off at many places. The bottom of the wooden boat coated with antifouling paint harboured very few barnacles and only 7 to 12 could be counted per sq. ft. (average 10 per sq. ft.).

According to Crisp and Barnes (1954), barnacles show a special preference to grooves and concavities on a substratum — a behaviour termed as "rugophilic", and the cyprids explore the surface very extensively before settling, and attachment to plane and smooth surface occurs only when such grooves and concavities are crowded. But the heavy settlement on the smooth hull of fibre-glass boat indicates that this predominant group among the fouling communities is capable of firmly attaching even to such a substratum. It is also interesting to note that, while the settlement on the fibre-glass sheathing on the wooden boat is very high, the same on other parts of the same boat, coated with antifouling paint is extremely scanty. The reason is that sheathing has invariably provided a non-toxic surface, which has also become comparatively rough as a result of damage and peeling, facilitating settlement.

The above observation and the earlier reports indicate that, in spite of its effectiveness as a protective sustratum against marine woodborers, boats, constructed of fibre-glass or wooden boats sheathed with fire-glass mat, are prone to heavy fouling. Therefore, such protective surfaces should be coated with a suitable marine antifouling paint to effectively check the fouling settlement. This is all the more important, as on boats and ships marine growth is a serious problem for their efficient and economic operation. It may be mentioned in this connection that from experiments it has been observed that even the smoothest hull of a ship with aluminium paint provided an extra resistance of 6%, and after 24, 30 and 58 days operation, the same was increased to 12%, 24% and 48% respectively, even when the fouling was light (B.S.R.A. experiment on the "Lucy Ashton", *Trans. Inst. Naval Arch., London,* Part I, 40 (1951); Part II, 350 (1950); Part IV, 525 (1955). Compared to this, the extra resistance offered by the extent of fouling noticed in the present case will be tremendous and warrants effective antifouling measures.

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We are grateful to Shri Rajan Abraham of Central Institute of Fisheries Education, Bomay, for his help during the preparation of this paper and to Shri J. C. Jain of Forest Research Laboratory, Bangalore and to Dr. S. N. Dwivedi, Director, C.I.F.E. Bombay, for their keen interest and encouragement during the course of this study.

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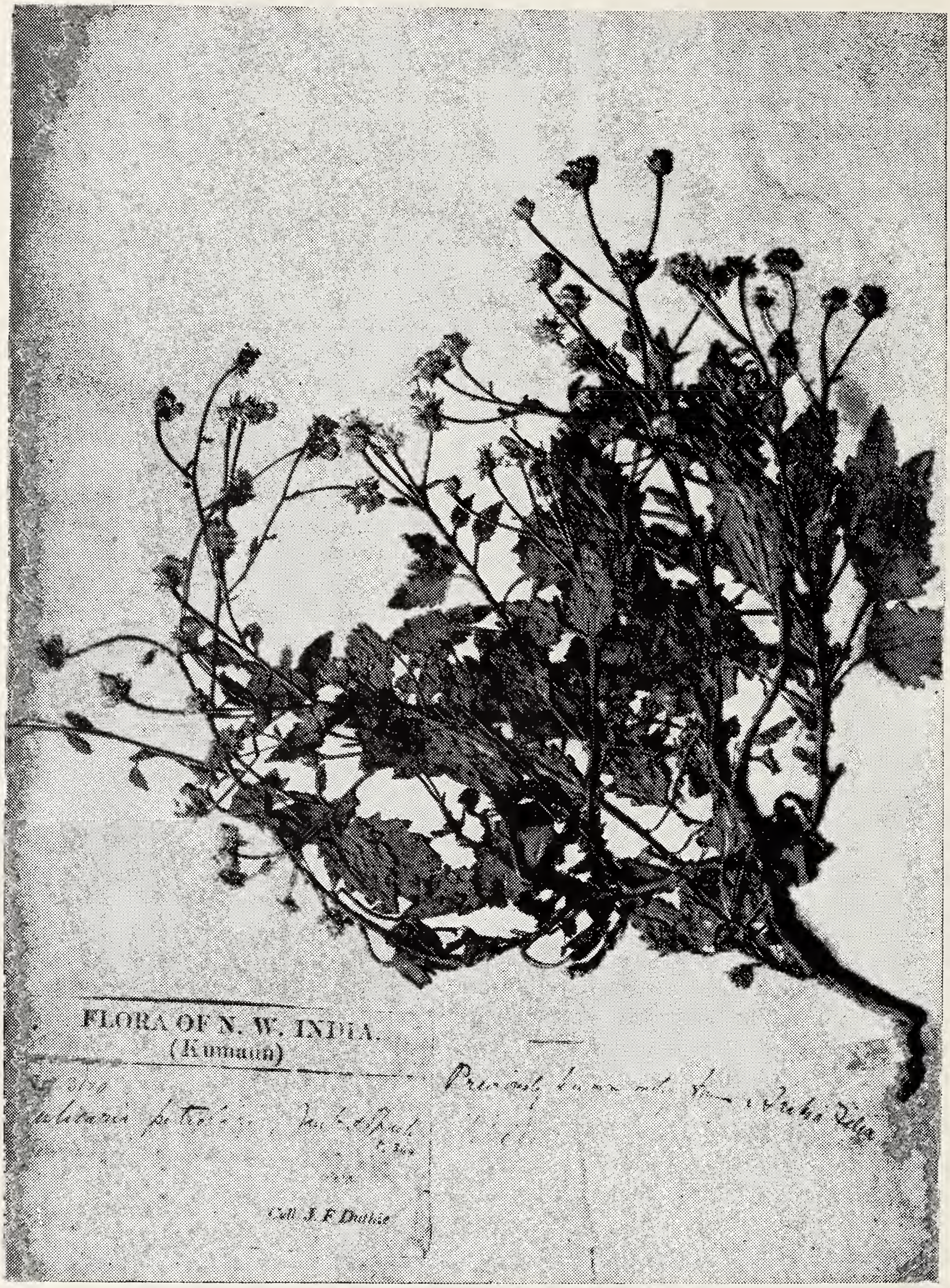
FLORA OF N. W. INDIA.
(Kumaun)
Coll. J. F. Duthie

Pulicaria petiolaris Jaub. et Spach.

23. *PULICARIA PETIOLARIS* JAUB. ET SPACH (ASTERACEAE) — A NEW RECORD FOR INDIA

(*With a plate*)

While revising the genus *Pulicaria* Gaertn. we came across a few interesting specimens collected by Duthie and Gamble (1884-1908) from Kumaon, Tehri Garhwal and Jaunsar, and lying un-noticed in the Herbaria of the Botanical Survey of India, Howrah (CAL) and the Forest Research Institute, Dehra Dun (DD). After a critical study and examination these specimens have been identified as *P. petiolaris* Jaub. et Spach. As far as we are aware, there is no report of its occurrence in India, and hitherto this species is known to occur from Arabia and Tropical Africa.

P. petiolaris Jaub. et Spach, Ill. Pl. Or. 69. t. 344. 1852; Oliver, Fl. Trop. Afr. 3: 364. 1877.

Suffruticose, 12-30 cm tall, with herbaceous branches; branches glandular with appressed hairs, irregular, divaricate, leafless below, leafy above. Leaves 1.25-5.0 cm long, 0.7-2 cm broad, alternate, oval or lanceolate, acute or subacute, cuneate, or truncate base, denticulate, petioles narrowly winged, more or less dilated at base. Capitula sub-hemispherical, many flowered, solitary on pedicels, loosely corymbose, radiate, involucral bracts unequal, imbricate, thinly glandular — pubescent, linear, acute or subulate, outer successively shorter. Achenes subfusiform, contracted at apex below the pappus, thinly pubescent; outer pappus shorter, inner or deciduous setae, barbellate above.

Rare on rocky slopes.

Flowers & Fruits: Mar.-Nov.

Specimens examined: Tons valley (Tehra Garhwal), 30.5.1898, Duthie, 21049 (DD); Khairna (Kumaon), 10.8.1884, Duthie, 3110 (DD); Jaunsar, Tuni, Nov. 1894, Gamble, 15067 (DD) & Jun. 1895, Gamble, 25561 (DD).

Distribution: AFRICA, ARABIA & INDIA.

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We thank Shri B. P. Uniyal, Botanist, Central National Herbarium, Botanical Survey of India for providing details of specimens and to the authorities of the Forest Research Institute, Dehra Dun for permission to consult their herbarium.

C. L. MALHOTRA
D. BASU

BOTANICAL SURVEY OF INDIA,
NORTHERN CIRCLE,
DEHRA DUN-248 001,
December 1, 1981.

24. THE CORRECT NAME OF 'MAROTTI' PLANT IN VAN RHEEDE'S HORTUS INDICUS MALABARICUS

'Marotti' plant in van Rheede's Hortus Indicus Malabaricus (1: 65. pl. 36. 1678) is an endemic species of Peninsular India, commonly known in Indian Floras (Hook. f. *et* Thomas. in Hook. f. Fl. Brit. Ind. 1: 196. 1872; Dunn in Gamble, Fl. Presid. Madras 1: 52. 1915) as *Hydnocarpus wightiana* Bl. Dennstedt (1818) in his bibliography to Rheede's Hortus Indicus Malabaricus (1678-1703) identified 'Marotti' as *Munnicksia laurifolia* Dennst. and this is the oldest name for the species. Based on the binomial *Munnicksia laurifolia,* Sleumer (Engl. Bot. Jahrb. 69: 33. 1939) proposed the combination *Hydnocarpus laurifolia* (Dennst.) Sleum. and considered it as the valid name for the species in his revision of the genus *Hydnocarpus* Gaertn. (Flacourtiaceae).

According to Rickett and Staffleu (Taxon 10: 80.1961), only those species names in Dennstedt's list are valid which are given under already validly published generic names and the new generic names coined there are all 'nomen nuda' because it is not allowed in the International Code of Botanical Nomenclature (1976) to validate a combined new generic and specific binomial by referring it to a previous publication. In this case both the generic name *Munnicksia* Dennst. and the specific epithet *'laurifolia'* were first coined by Dennstedt (1818) by referring the binomial to the plate 'Marotti' in Hortus Malabaricus. Hence the binomial *Munnicksia laurifolia* is a 'nomen nudum' at the time of its publication and accordingly Munitz (Taxon 17: 501.1968) included it in the 'nomen nuda' list of the names in Dennstedt's (1818) Schlussel zum Hortus Indicus Malabaricus. Thus Sleumer's (loc. cit.) combination *Hydnocarpus laurifolia* based on the 'nomen nudum' *M. Laurifolia* is also not valid.

Francis Hamilton (Trans. Linn. Soc. London 13: 501. 1822) described the species *Chilmoria pentandra* Ham. based on the plate 'Marotti' in Hortus Malabaricus. This binomial is the oldest validly published name for the plant and based on it, Oken (Allg. Naturgesch. 3(2): 1381. 1841) proposed the combination *H. pentandrus* (Ham.) Oken. According to the International Code of Botanical Nomenclature (1976), *H. pentandrus* is a validly published name and it is the correct one for the 'Marotti' plant in Hortus Malabaricus. However Oken (loc. cit) included 'Pangium' of Rumphius (Herb. Amb. 2: 182. pl. 59. 1741) also as a synonym of *Hydnocarpus pentandrus,* which is not correct as 'Pangium' is a different plant botanically known as *Pangium edule.*

Wight and Arnott (Prodr. 30. 1834) identified Rheede's plate 'Marotti' as *Hydnocarpus inebrians* Vahl, and Dunn (*loc. cit.*) treated *H. inebrians* as a synonym of *H. wightiana.* But *H. inebrians* is an endemic species of Sri Lanka and it is a different plant from *H. pentandra* (*H. wightiana* Bl.) which is confined to Peninsular India. Thus Hooker and Thomson (loc. cit.) were correct in treating *H. inebrians* Vahl and *H. wightiana* Bl. as two distinct taxa. The correct nomenclature of Rheede's 'Marotti' plant is as given below.

Hydnocarpus pentandrus (Ham.) Oken, Allg. Naturgesch. 3(2): 1381. 1841. — *Chilmoria pentandra* Ham. Trans. Linn. Soc. London 13: 501. 1822. — *Hydnocarpus wightiana* Bl. Rumph. 4: 22. 1848, Hook. f. *et* Thoms. in Hook. f. Fl. Birt. Ind. 1: 196. 1872; Brandis, Indian Trees 42. fig. 17. 1906; Dunn in Gamble, Fl. Presid. Madras 1(1): 52. 1915. — *H. laurifolia* (Dennst.) Sleum. in Engl. Bot. Jahrb. 69: 33. 1939; Ramamurthy in Fl. Hassan Distr. 164. 1976 — *Munnicksia laurifolia* Dennst. Schluess. Hort. Ind. Malab. 13. 1818. c. f. Hassk. Flora 45: 44. 1862. — *H. inebrians sensu non* Vahl; Wt. *et* Arn. Prodr. 30. 1834; Wt. Illus. Ind. Bot. t. 16. 1840.

Distribution: Western Peninsular India from South of Maharashtra in evergreen, semi-evergreen and wet deciduous forests.

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I am thankful to the Deputy Director, Central National Herbarium, Botanical Survey of India, Howrah for all facilities.

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25. IDENTITY AND DISTRIBUTION OF *AGERATUM HOUSTONIANUM* MILLER (COMPOSITAE) IN INDIA

(*With three text-figures*)

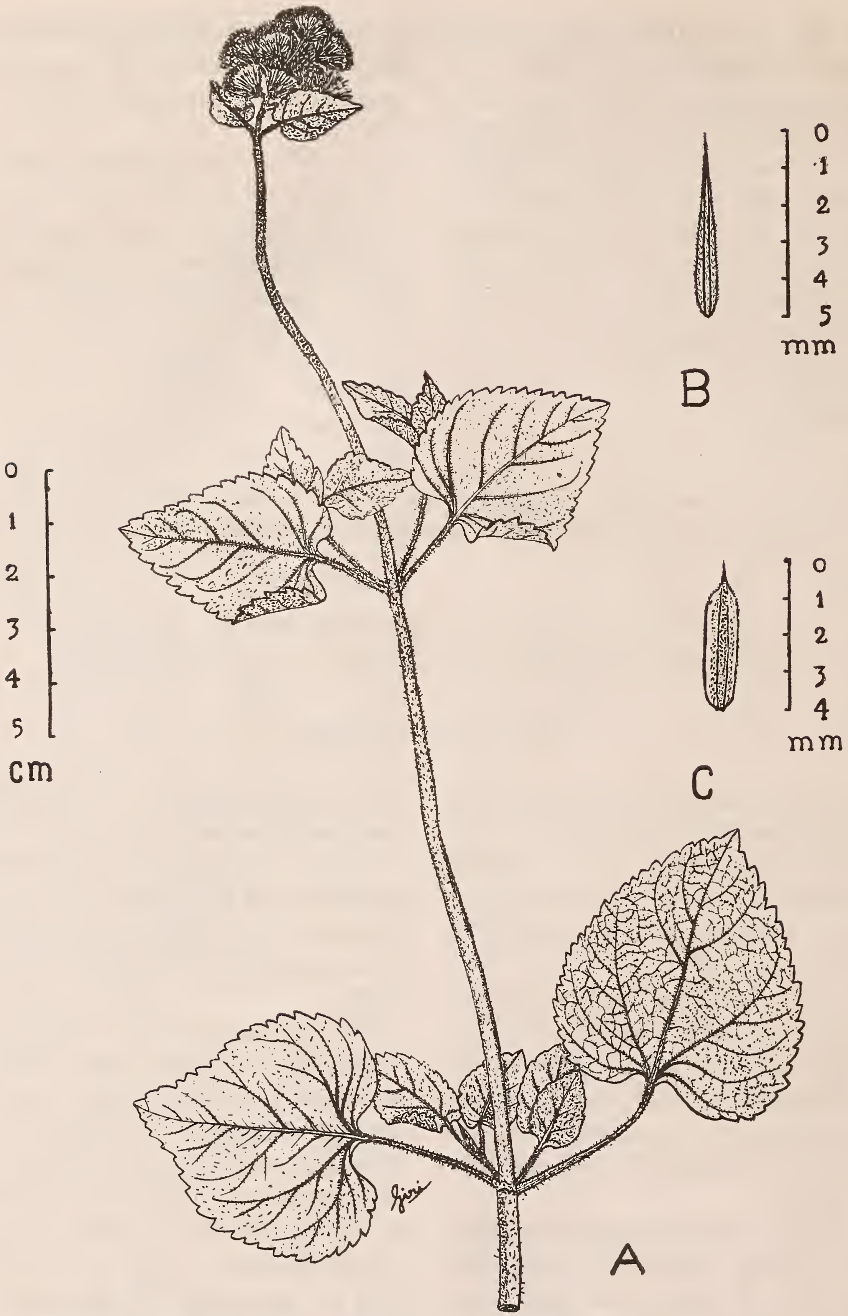
Babu (1977) has recorded *Ageratum houstonianum* Miller, so far known from tropical America, from Dehra Dun, Uttar Pradesh, and has stated that it is naturalised there. He has remarked "This may be a cytotype of *A. conyzoides* L."

Bhandari (1978) recorded the species from Jodhpur, Rajasthan, with citation of a few specimens. He gave the distribution of the species in Tamilnadu, Assam and Karnataka without any reference to specimens. He has also noted that he is doubtful about the identity of the species.

Johnson (1971), in his monograph, remarks "an *Ageratum* species collected in India must be **A.** *conyzoides,* as this is the only taxon found beyond the limit of the Western hemisphere." It is probably due to this remark of Johnson that the later Indian floristic workers hesitated to accept *A. houstonianum,* with confidence, as an Indian plant.

After a thorough study of the Indian specimens labelled as *A. conyzoides* in the Calcutta herbarium, we realised that it is in fact a mixed lot containing *A. conyzoides* and *A. houstonianum.*

The specimens of *A. houstonianum* have been sorted out and after critical study with reference to the American specimens in the Central National Herbarium, it has been observed that *A. houstonianum* is a widely distributed and naturalised species in India. It was collected in Assam as early as 1895 and in Punjab as early as 1896. From this it may be presumed that the species was introduced to India in the last part of the nineteenth century and then gradually naturalised itself spreading all over the country. Being con-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A. Habit of *Ageratum houstonianum* Miller drawn from the specimen *N. C. Majumdar* 191.
B. Involucral Bract of *A. houstonianum* Miller.
C. Involucral Bract of *A. conyzoides* L.

fused with *A. conyzoides*, its occurrence in India was not known. The species is found in different states of India. None has so far recorded the occurrence of the species from Arunachal Pradesh, Sikkim, Meghalaya, West Bengal, Delhi and Punjab, which is done here for the first time.

A. cordifolium Roxb. (1832) from Bengal refers to the cordate nature of leaf-bases, but it has involucral bracts exactly like those of *A. conyzoides*. So it becomes a synonym of *A. conyzoides*.

As mentioned by Johnson, *A. houstonianum* is closely related to *A. conyzoides* as shown by their similar habit, achenes, pappus, corollas and the malodorous nature when fresh, due to which the two are often confused in herbaria, botanical gardens and in the field. However, the combination of ovate leaves with cordate bases, and narrowly lanceolate, conspicuously pilose involucral bracts with stipitate glandular pubescence on the gradually acuminate apex distinguishes *A. houstonianum* from similar species.

To avoid confusion, the contrasting characters of the two species are tabulated below:

Ageratum houstonianum miller, Gard. Dict. Ed. 8, 1768. *A. conyzoides* Lam. Ill. Gen. Pl. Bot. 248, Pl. 672. 1823. Holotype: Mexico, Vera Cruz, *William Houston* s.n. (BM).

Distribution: Antigua, British Honduras, Colombia, Cuba, Guatemala, Jamaica, Mexico, Peru, Sumatra, Java, Madeira, Nepal, India.

INDIA: Arunachal Pradesh, Assam, Delhi, Meghalaya, Punjab, Rajasthan, Sikkim, Tamilnadu, Uttar Pradesh, West Bengal.

Chromosome No.: n = 10 (Turner *et al.* 1962).

Specimens Examined: WEST BENGAL: Darjeeling, 1500 m., 28-4-1965, *Santapau* 225. ASSAM: Cinnamond, 26-4-1895, *G. Watt* 11322; Assam, without precise locality, *S. N. Bal* 641; Sonaikushi R. F., south of Nakhola town, Nowgong, 18-4-64, *N. P. Balakrishnan* 39231; Dharikati, Assam, 16-2-57, *G. Panigrahi* 5646; Tangla, 24-4-1958, B. K. Nath 13396; Upper Dihing Reserve, 8-7-1959, *G. Panigrahi* 18713. MEGHALAYA: Upper Shillong, Khasi hills, 26-11-1956, *G. Panigrahi* 4727. MIZORAM: Mizo hills, *R. M. Datta* 33400. ARUNACHAL PRADESH: Kameng foothills, 240 m., 22-3-1957, *G. Panigrahi* 5844. UTTER PRADESH: Pilibhit 15-9-1972, *C. L. Malhotra* 50841. DELHI: I.A.R.I., New Delhi, March 1950, *Sewa Singh* 12; PUNJAB: Gagret,

A. conyzoides L.	*A. houstonianum* Mill.
1. Stem pilose when young, older parts glabrate or glabrous.	1. Stem pilose throughout, the younger parts densely pilose.
2. Leaves ovate, base obtuse or oblique or rarely rounded but never cordate or truncate, sparsely pilose, margin crenate, petiole sparsely pilose.	2. Leaves broadly ovate, base cordate or truncate, more pilose on both surfaces, margin dentate, serrate, biserrate or crenate.
3. Peduncle sparsely puberulent-pilose.	3. Peduncle densely pilose.
4. Involucral bracts oblong to oblong-lanceolate, greenish with hyaline margin, very sparsely pilose, glabrate or glabrous, apex abruptly acuminate or acute, erose or fimbriate, margin entire.	4. Involucral bracts linear-lanceolate, green, grayish or brownish, 2-ribbed, densely pilose, apex gradually long-acuminate, glandular-ciliate, especially above, margin entire.
5. Corolla shorter, 1.5-2.5 mm, glabrous or apically puberulent.	5. Corolla longer, 2.5 — 3.5 mm, glabrous to glandular.

18-4-1972, *O. P. Misra* 47090; Amritsar, 9-3-1896, *D. Prain* s.n.; RAJASTHAN: Hindoli, 23-12-1963, *D. M. Verma* 1873; Jhalar Patan, Jhalwar, 23-4-1964, *D. M. Verma* 3352; Mandore Garden, Nagadhari, *G. P. Roy* 1525; Mandore Garden, 21-1-1974, *G. L. Tiwari* 1118; Ahu River, Jhalawar, 27-5-1965, *B. M. Wadhwa* 9499; TAMILNADU: Combai river bed, 14-6-1961, *K. M. Sebastine* 12579; Gedasal, Coimbatore, 1215 m., without collector's name, 4224; Shembaganur, 1820 m., 1913, *Rev. Aug. Saulieres* 903; Nilgiri, 1366 m., June 1883, *J. S. Gamble* 12154; Kotagiri, Aravenu, 2000 m., 4-1-1957, *K. Subramanyam* 1886; Kotagiri, 22-10-1956, *K. Subramanyam* 1049; Kottabettu, Illithorai, 2067 m., 8-10-1956, *K. M. Sebastine* 966; SIKKIM: Gangtok, 1670 m., 5-9-1968, *N. C. Majumdar* 191; NEPAL: Gokarna, *Ramola & Prova* s.n.; HAWAII: Hilo suburb, March 1966; *O. Degener & I. Degener* 30793; U.S.A.: New York Botanical Garden, 760 m., (1898-1901) *Herbert H. Smitt* 623 (*A. mexicanum* Sims.); VENEZUELA: Prope coloniam Tovar, 1854-55, *A. Fendler* 652; Ex Hort. Bot. Petropol....CAL Acc. No. 225010 & 225011 (*Ageratum mexicanum* Sweet); Ex Hort. Bot. Petropol....CAL Acc. No. 225012 (*A. conyzoides* L. var. *mexicanum* DC.)

BOTANICAL SURVEY INDIA,
HOWRAH 711 103,
October 12, 1981.

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N. C. MAJUMDAR

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26. RARE OR NEW *EXACUM* L. (GENTIANACEAE) FROM SOUTHERN INDIA

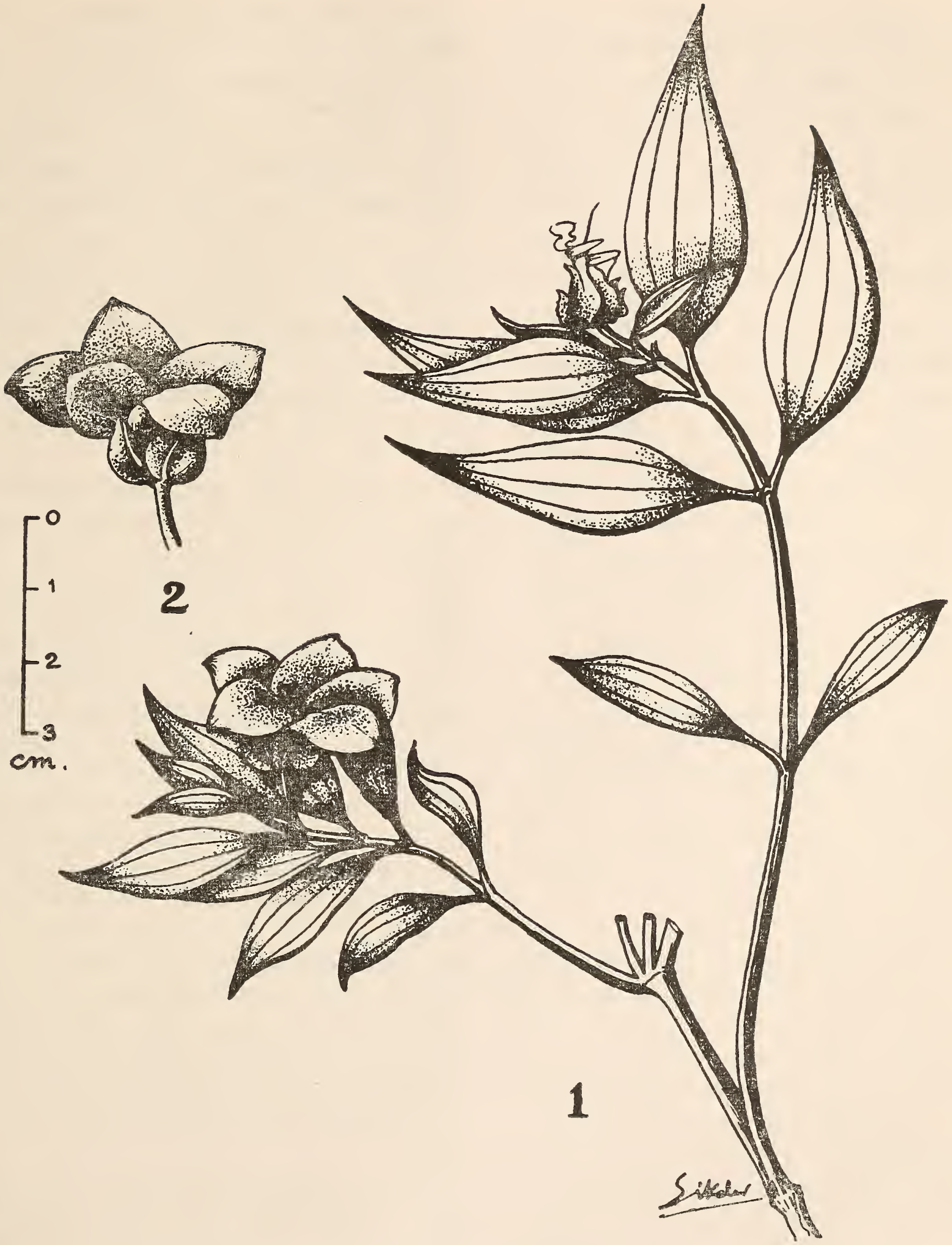
(*With two text-figures*)

During systematic studies on the flora of Kanniyakumari and Tirunelveli Districts of Tamil Nadu, Southern India, several taxa of *Exacum* L. (Gentianaceae) were collected from the ghat forests. The rare and the new among them are described in this paper; the specimens cited are from MH.

Exacum atropurpureum Bedd. Ic. t. 119. 1868-1874; Clarke in Hook. f. Fl. Brit. India 4: 97. 1883; Gamble, Fl. Pres. Madras 2: 614. 1957 (repr. ed.).

Erect bushy herbs, glabrous. Leaves up to 7 x 5 cm, sessile and stem-clasping, ovate to suborbicular, entire, thick, acute or shortly acuminate at apex, rounded or subcordate at base, 3-5-nerved. Flowers up to 4.5 cm long, blue, solitary in upper leaf-axils, pedicelled.

Beddome *l.c.* t. 119 (and *letter press* t. 154) described this species based on his collection from Travancore Hills. Beddome's collection of "*E. atropurpureum*" from Palghat has since been described as *E. atropurpurem* var. *pal-*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Sikdar

Figs. 1-2. *Exacum wightianum* Arn var. *uniflorum* var. nov.
1. Portion of plant; 2. Flower.

ghatense Gamble. The paucity of the material of this species is revealed in Gamble's remark made on the herbarium sheet-*Bourdillon* 23 (MH): "Desideratum. No specimen at Kew". We have since re-located this plant in the upper Kodayar area of the Kanniyakumari Dt., Tamil Nadu, after a lapse of over six decades.

Distribution: Endemic to India (S. W. Ghats).

Specimens Examined: KERALA. Trivandrum Dt.: Trivandrum, October, 1884, *Bourdillon* 23; Travancore hills, 1869, *Beddome s.n.* TAMIL NADU. Kanniyakumari Dt.: Upper Kodayar, 1400 m, 30-9-1980, *Henry* 68873; Tirunelveli Dt.: Aghasteer hill, 4500 ft., *Beddome s.n.;* Agastiarmalai, 22-5-1901, *Barber* 2889; Kalivayalpil, 1-6-1901, *Barber* 3023; Naterikal, 22-9-1916 & 23-9-1916, *s.l.*, Travancore boundary near Naterikal, 4-3-1917, *s.l.*

E. courtallense Arn. var. **laxiflorum** Gamble, Fl. Press. Madras 873. 1923.

Stunted herbs, up to 40 cm tall. Leaves up to 7 x 2 cm, lanceate, entire, glabrous, thick margined, acuminate at apex, cuneate at base, sessile, trinerved. Flowers up to 1.5 cm long, blue, in lax leafy cymes; pedicels up to 2.5 cm long. Calyx lobes up to 1.5 cm long, narrowly lanceate, many-nerved.

This distinct variety was described by Gamble *l.c.* based on the collections of Beddome from Travancore hills made around 1873. The type specimens are deposited in MH and K. We have recently collected this threatened plant from the grassy slopes of Muthukuzhivayal in Kanniyakumari Dt., Tamil Nadu.

Since Gamble *l.c.* failed to indicate the type or holotype from among the specimens discussed in the protologue, the herbarium specimen — Travancore, 1873, *R. H. Beddome s.n.* (MH, acc. no. 33198) is designated as the lectotype of this variety.

Distribution: Endemic to India (S. W. Ghats).

Specimens Examined: KERALA. Travancore Hills, *Beddome s.n.* (syntype); Travancore, 1873, *Beddome s.n.* (MH-acc. no. 33198-Lectotype); Trivandrum Dt.: Forest near Boneccord Estate, 500 m, 1-10-1973, *Joseph* 44484. TAMIL NADU. Kanniyakumari Dt.: Muthukuzhivayal, 1000 m, 31-8-1976, *Henry* 48174; Tirunelveli Dt.:Mahendragiri, 18-9-1916, *s.l.*

E. travancoricum Bedd. Ic. t. 118. 1868-1874; Gamble, Fl. Pres. Madras 2: 614. 1957 (repr. ed.). *E. courtallense* Arn. var. *travancorica* (Bedd.) Clarke in Hook.f. Fl. Brit. India 4: 97. 1883.

Low, bushy herbs; stems up to 20 cm tall, erect, woody below, much branched, somewhat 4-winged. Leaves up to 2.5 x 1 cm, very closely arranged, spathulate, incurved and plicate, somewhat fleshy, glabrous, obtuse and reflexed at apex, tapering at base. Flowers blue, solitary near ends of leafy branches; pedicels up to 3.5 cm long. Capsules 1-1.4 x 0.6-0.8 cm, ovoid, pointed at apex, 2-valved.

Beddome *l.c. letter press* t. 154 states: "The very caespitose fleshy leaved *E. travancoricum* is a most distinct species, and one of the most beautiful plants in this Presidency". He collected this species from "Attraymallay in Travancore". We have since relocated this plant from Agastyamalai in Tirunelveli Dt., as well as from Muthukuzhivayal in Kanniyakumari Dt. of Tamil Nadu. When in full bloom this plant gives a beautiful appearance and hence worth introducing in Horticulture.

Distribution: Endemic to India (S. W. Ghats).

Specimens Examined: KERALA. Travancore Hills, 4500 ft., *Beddome s.n.;* Trivandrum Dt.: Western slopes of Agastyamalai, 1800 m, 6-10-1973, *Joseph* 44586. TAMIL NADU. Kanniyakumari Dt.: Muthukuzhivayal, 1400 m, 9-9-

1976, *Henry* 48294; Tirunelveli Dt.: Agastiarmalai, 22-5-1901, *Barber* 2888; Agastyamalai, 1400 m, 26-8-1963, *Henry* 17336; Agastyamalai peak, 1400 m, 1-7-1964, *Henry* & *Chandrabose* 19189.

E. wightianum Arn. var. **uniflorum** var. nov.

A typo differt, floribus paucioribus praecipue solitaribus.

Holotypus (*Henry* 16335, CAL) et isotypi (*Henry* 16335, MH — acc. no. 109135-109137) lecti ad collibus Agastyamalai dist. Tirunelveli in provincia Tamil Nadu die 27-5-1963; paratypi (*Henry* & *Chandrabose* 19181, MH — acc. no. 109138-109144) lecti eodem in loco die 1-7-1964; paratypus (MH — acc. no. 33194) lecti eodem in loco; et paratypus (*Barber* 3023 B, MH — acc. no. 331995) lecti ad collibus Kalivayalpil dist. Tirunelveli in provincia Tamil Nadu die 1-6-1901.

This new variety differs from *E. wightianum* Arn. var. *wightianum* in having few, mostly solitary flowers.

Subshrubby herbs up to 2 m tall; stem glabrous, much branched. Leaves up to 10 x 4 cm, elliptic-lanceate to ovate-lanceate, membranous, greenish above, somewhat glaucous beneath, acuminate at apex, attenuate at base. Flowers blue, few, mostly solitary. Capsules 8-12 x 7-8 mm, sub-globose or egg-shaped, glabrous, shining, septicidally 2-valved. (Figs. 1-2).

Holotype (*Henry* 16335, CAL) and isotypes (*Henry* 16335, MH — acc. no. 109135-109137) were collected in Agastyamalai hills in Tirunelveli District, Tamil Nadu on 27-5-1963; paratypes (*Henry* & *Chandrabose* 19181, MH — acc. no. 109138-109144) were collected from the same locality on 1-7-1964; paratype (MH — acc. no. 33194) was collected from the same locality, and paratype (*Barber* 3023B, MH — acc. no. 33195) was collected in Kalivayalpil, near Agastyamalai hills in Tirunelveli district on 1-6-1901.

This variety was found fairly common along exposed wet grassy slopes at the top of the hill.

ACKNOWLEDGEMENT

We are thankful to Dr. N. C. Nair, Joint Director, Botanical Survey of India, Coimbatore for facilities and encouragement.

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M. S. SWAMINATHAN

BOTANICAL SURVEY OF INDIA,
COIMBATORE 641 003,
September 18, 1981.

27. *AVENA LUDOVICIANA* DUR. (POACEAE) — NEW TO WEST BENGAL

During the course of identification of material of the family Poaceae we came across a specimen of the genus *Avena* which on critical study proved to be *Avena ludoviciana* Dur.

Bor (1960) recorded its distribution in India from North West India (Jammu & Kashmir and Kumaon).

It has not been so far reported from the eastern part of India. A specimen collected by *A. K. Naskar* from Howrah district, West Bengal is the first record of its distribution in West Bengal.

A short description is presented here: (for illustration See Hubbard's Grasses 240. 1954.)

Annual, 10-30 cm high, culms 15 cm long, slender. Leaves 12-20 mm long, 4-10 mm wide, linear lanceolate, glabrous. Panicles nodding, very loose. Spikelets 15-20 mm long, pendulous, 2-3 flowered. Glumes persistent, nearly equal, 15-16 mm long, lanceolate, rounded on the back, 7-nerved, finely papyraceous with a hyaline tip. Lemmas 15-16 mm long and 3.3 mm wide, narrowly lanceolate, cartilaginous, hairy in the lower half, 6-nerved, scabrid, two cleft, awn dorsal below the cleft, 30-45 mm long with twisted base. Paleas 12 mm long, lanceolate, 2-keeled. Anthers 3. Ovary hairy.

Avena ludoviciana Dur. resembles *A. sterilis* but differs mainly in having (1) smaller spikelets, (2) smaller lowest lemma.

Specimen examined: West Bengal, Howrah district, Thanamakua, 22-2-1970, A. K. Naskar 38 (CAL).

ACKNOWLEDGEMENTS

We thank Dr. K. Thothathri for encouragement and Dr. C. R. Das for suggestions.

RATNA DUTTA
ANIL KUMAR NASKAR

BOTANICAL SURVEY OF INDIA,
CENTRAL NATIONAL HERBARIUM,
SIBPUR, HOWRAH 711 103,
September 5, 1981.

28. ON OCCURRENCE OF *JUNCUS MARITIMUS* LAM. IN SAURASHTRA

Many species of *Juncus* are known to yield high quality of cellulose for paper production (Zahran *et al.* 1979). *J. maritimus* is a salt tolerant halophyte which has been reported from Sind, Afghanistan, North and South America and Australia (Hooker 1894). In India Jain (1960) reported its occurrence for the first time in Kutch region. Since then the coastal flora has been extensively reported on (Rao and Safai 1963; Rao and Aggarwal 1964 a, b, 1966; Rao *et al.* 1966; Rao and Mukherjee 1967) but this species has not been recorded so far from any other part of India.

J. maritimus was recently found on the coastal region near Avania village, 9 Km away from Bhavnagar (21° 45′ N 72° 14′ E) alongwith *Aeluropus lagopoides*. It was also noticed at Gogha, 15 km away from Bhavnagar alongwith *Eriocaulon* sp. and *Cyperus* sp. (Vora, personal communication). The salt tolerance of this species is being studied in detail by me on account of its being a promising halophyte for reclamation of saline soils.

I thank Dr. E.R.R. Iyengar, Assistant Director, CSMCRI, Bhavnagar for encouragement and Dr. B. D. Sharma, Dy. Director, BSI, Poona for confirming identification.

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BHAVNAGAR 364 001,
August 18, 1981.

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29. CONTRIBUTION TO THE FERNS OF MIZORAM

INTRODUCTION

Mizoram (previously known as Lushai Hills or Mizo-Hills district) situated in the north-eastern corner of India, is flanked by Bangladesh and Tripura on the west and Burma (Chin Hills) on the east and south. On the north, are Manipur and Cachar Districts of Assam. It has remained practically unexplored due to its difficult hilly terrain and inaccessible disturbed forest areas. Gage (1899) and Fischer (1938) listed the ferns of Southern Lushai Hills. During 1963, we surveyed Aizal area and made an extensive collection of ferns along with the other groups of plants between the altitudinal range of 600-800 m. The present communication which deals with the ferns only, is the first record of the area.

The Mizo hill ranges extend from north to south at an average height of *c.* 900 m, with rather steep slopes separated by fast flowing rivers which create deep gorges between the hill ranges. The climate is generally cool in summer (temperature ranges from 18°C to 29°C) and not very cold in the winter (temperature varies from 11°C to 24°C); the average rainfall is 208 cm. The vegetation of the area is dominated mainly by epiphytes, scitaminous plants, aroids and ferns.

ENUMERATION OF SPECIES

The arrangement of the families followed here is after Ching (1978). Species under each genus are arranged alphabetically, along with a brief account of ecology. Voucher specimens are deposited in the herbarium of the National Botanical Research Institute, Lucknow (LWG).

LYGODIACEAE Presl
Lygodium Swartz

L. flexuosum (L.) Sw. Schrad. Journ. Bot., 106. 1801; Bedd., Handb. Ferns Brit. Ind. 457. 1883.

In scattered patches at lower altitude: *P. & S. Chandra*, LWG 81165.

LINDSAEACEAE Ching ex Pichi Sermolli
Lindsaea Dryander apud Smith

L. ensifolia Sw. Schrad. Journ. Bot., 77. 1801. *Schizoloma ensifolia* Sw., Bedd. Handb. Ferns Brit. Ind. 80. 1883.

Schizoloma ensifolia (Sw.) Alston in Bot., Soc. Broter. Ser. 2, 30:24. 1956.

Common on wet hill slopes in crevices of rocks: *P. & S. Chandra,* LWG 81184.

PTERIDACEAE Ching
Pteris L.

P. pellucida Presl, Rel. Haenk., 1: 55. 1825; Bedd. Handb. Ferns Brit. Ind. 106. 1883.

In comparatively dry and exposed places at lower altitude *c.* 800 m. Not common: *P. & S. Chandra,* LWG 81169.

SINOPTERIDACEAE Koidzumi
Aleuritopteris Fee

A. farinosa (Forsk.) Fee, Gen. Fil., 154, t 12 B. f1, 1852. *Cheilanthes farinosa* (Forsk.) Kaulf., Enum. Fil., 212. 1824, Bedd. Handb. Ferns Brit. Ind. 92. 1883.

In rock crevices at rather exposed places; very common on road sides: *P. & S. Chandra,* LWG 81162.

Onychium Kaulf.

O. siliculosum (Desv.) C. Chr., Index Fil. 20. 1905; 469. 1906; *Onychium auratum* Kaulf., Bedd. Handb. Ferns Brit. Ind. 96. 1883.

Common on road sides and exposed clayey hill slopes at lower altitudes between 100-300 m: *P. & S. Chandra,* LWG 811930.

ADIANTACEAE (Presl) Ching
Adiantum L.

***A. assamicum** (Nayar) Nayar, in Bull. natn. bot. Gdns. no. 94: 1. 1964. *A. caudatum* L. var. *assamicum* Nayar in Bull. natn. bot. Gdns. no. 52: 10. 1961.

Very common in plains and foot hills, on more or less exposed hill slopes and in moderately dry localities: *P. & S. Chandra,* LWG 81183.

HEMIONITIDACEAE Pichi-Sermolli
Pityrogramma Link

P. calomelanos (L.) Link., Handb. Gewachs: 3: 20. 1883; Holtt., Fl. Malaya 2: The Ferns: 593. 1968; Schelpe, Fl. Zam., 170 (1970).

Common especially on earth cuttings and forest clearings, forming isolated dense clumps near water drains: *P. & S. Chandra,* LWG 81161.

ATHYRIACEAE Alston
Athyrium Roth

A. falcatum Bedd., Ferns S. Ind. 151. 1863; Nayar and Kaur, Comp. Bedd. Ferns Brit. Ind. 40. 1974.

Sparsely distributed on hill slopes and by the sides of water channels and water falls: *P. & S. Chandra,* LWG 81160.

Diplazium Swartz

D. umbrosum (J. Smith under *Athyrium*) Bedd. Handb. Ferns Brit. Ind. 188. 1883; Nayar and Kaur, Comp. Bedd. Ferns Brit. Ind. 45. 1974.

Growing gregariously in shady and humid dense forests: *P. & S. Chandra,* LWG 81185.

THELYPTERIDACEAE Ching ex Pichi Sermolli
Cyclosorus Link

C. crinipes (Hook.) Ching in Bull. Fan Mem. Inst. Biol. Bot. 8:179. 1938. *Nephrodium crinipes* Hook., Spec. Fil. 4:71. 1862; Bedd. Handb. Ferns. Brit. Ind. 279. 1863. *Christella crinipes* (Hook.) Holtt., Kew Bull. 31:326. 1976.

Common near waterfalls and water channels: *P. & S. Chandra,* LWG 81199.

C. evolutus (Bedd.) Ching in Bull. Fan Mem. Inst. Biol. Bot. 8:219. 1938. *Nephrodium evolutum* Bedd., Handb. Suppl. Ferns Brit. Ind. 76. 1892. *Christella evoluta* (Bedd.) Holtt., Kew Bull. 31:330. 1976.

Common in humus-rich forests: *P. & S. S. Chandra,* LWG 81176, 81198.

Metathelypteris (H. Ito) Ching

M. gracilescens (Bl.) Ching in Acta Phytotax. Sin. 8:305. 1963; Holttum, Philipp. J. Biol. 5: 116. 1976. *Lastrea gracilescns* Bl., Bedd. Handb. Ferns Brit. Ind. 234. 1883.

Common in humus-rich forests: *P. & S. Chandra,* LWG 81195.

Pronephrium Presl

P. lakhimpurense (Rosenst.) Holtt., Blumea 20:110. 1972; in Nayar and Kaur, Comp. Bedd. Ferns Brit. India, 95, 1974.

Common in moist shaded places: *P. & S. Chandra,* LWG 81175.

P. nudatum (Roxb.) Holtt., Blumea, 20:111. 1972; in Nayar and Kaur, Comp. Bedd. Ferns Brit. India, 66, 1974.

In somewhat exposed forest areas and by the side of river beds: *P. & S. Chandra,* LWG 81187.

Pseudocyclosorus Ching

P. ciliatus (Wall. ex Benth.) Ching, Acta phytotax. Sin 8:324. 1963. *Trigonospora ciliata* (Benth.) Holtt., in Nayar and Kaur, Comp. Bedd. Ferns Brit. India, 203, 1974.

Growing on rocks near and on beds of streams where it is frequently sumberged in the rainy season: *P. & S. Chandra,* LWG 81157.

ASPLENIACEAE Mett. ex Frank
Asplenium L.

A. crinicaule Hance, Ann. Sci. Nat. Ser, 5:254. 1866; Bedd. Handb. Ferns Brit. Ind. 150. 1883.

Quite common on tree trunks and moss covered rocks between 500-600 m: *P. & S. Chandra,* LWG 81177.

A. excisum Pr., Epim, Bot. 74. 1851; Nakaike, Enum. Jap. Pterid. Filicales:96. 1975. *A. unilaterale* var. *majus* (C. Chr.) Sledge, Bull. Brit. Mus. (N.H.) Bot. 3:246. 1965. *A. unilaterale* Bedd., Handb. Ferns Brit. Ind.: 152. 1883 (p.p.)

On wet rocks by streams and on wet banks; common in primary forest: *P. & S. Chandra,* LWG 81181.

A. finlaysonianum Wall. ex Hook., Icones Pl., t. 937. 1854. *Hemidictyum finlaysonianum* Hook., Bedd. Handb. Ferns Brit. Ind. 195. 1883.

On wet soils in shade, occasionally occurring on tree trunks: *P. & S. Chandra, LWG* 81169, 81191.

BLECHNACEAE Ching ex Copel.
Blechnum Linn.

B. orientale Linn., Spec. Pl., 2 : 1077. 1753; Bedd. Handb. Ferns Brit. Ind. 132. 1883; Ching, Acta Phytotax. Sin. 16:14. 1978.

In fully exposed areas, on roadsides and river banks: *P. & S. Chandra,* LWG 81192.

DRYOPTERIDACEAE Ching
Dryopteris Adanson

D. sparsa (Ham. ex D. Don) Kuntze, Rev., Gen. Pl. 2:813. 1891; Sledge, Bull. Brit. Mus. (N. H.) 5:13. 1973. *Lastrea sparsa* Don. Bedd. Handb. Ferns Brit. Ind. 252. 1883 excl. parte.

Common in low-altitude mountain forest: *P. & S. Chandra,* LWG 81197.

Polystichum Roth.

P. biaristatum (Bl.) Moore, Index Fil. : 86. 1858; Sledge, Bull. Brit. Mus. (N.H.) Bot. 5:35. 1973. *Polystichum aculeatum* Sw. var. *biaristatum* Bl., Bedd. Handb. Ferns Brit. Ind. 209. 1883;

On rather dry slopes in dense evergreen forests: *P. & S. Chandra,* LWG 81179.

P. lentum (D. Don) Moore, Index Fil., 86. 1858. *Polystichum auriculatum* Linn., Type var. *lentum* Don, Bedd. Handb. Ferns Brit. Ind. 204. 1883.

Common in semi exposed places throughout the valleys: *P. & S. Chandra,* LWG 81180.

ASPIDIACEAE Mett. ex Frank
Tectaria Cavanilles

T. fuscipes (Wall. ex Bedd.) C. Chr., Contr. U.S. Nat. Herb., 26:290. 1931. *Pleocnemia membranifolia* Presl, Bedd. Handb. Ferns Brit. Ind. 225. 1883 (p.p.)

Common at low altitudes, occurring scattered in dry, shady places: *P. & S.* Chandra, LWG 81188.

T. polymorpha (Wall. ex Hook.) Copel., Philipp. J. Sci., 2 C: 413. 1907. *Aspidium polymorphum* Wall., Bedd. Handb. Ferns Brit. Ind. 218. 1883 (p.p.)

Low-land species, usually growing near water: *P. & S. Chandra,* LWG 81172, 81182.

BOLBITIDACEAE (Pichi-Sermolli) Ching
Bolbitis Schott

B. appendiculata (Willd.) K. Iwats. ssp. **appendiculata** Hennip., Leiden Univ. Bot. Ser. 2: 190. 1977. *Egenolfia appendiculata* (Willd.) J. Sm., Nayar and Kaur in Bull. natn. bot. Gdns., no. 100:17. 1964.

Creeping on rocks and soil at moist places in deciduous and evergreen forest: *P. & S. Chandra,* LWG 81154.

B. scalpturata (Fee) Ching in C. Chr., Ind. Fil., Suppl. 3:50. 1934; Hennip., Leiden Univ. Bot. Ser. no. 2:163. 1977.

On slopes in the forest and on boulders in stream beds: *P. & S. Chandra,* LWG 81152.

B. sinensis (Baker) K. Iwats., Acta Phytotax. Geobot. 18:49. 1959; Hennip., Leiden Bot. Ser. no. 2:202. 1977. *Egenolfia sinensis* Maxon; Nayar and Kaur in Bull. natn. bot. Gdns. Lucknow. 100:32. 1964.

Usually terrestrial, creeping either on soil or on rocks, sometimes epiphytic in evergreen forest: *P. & S. Chandra,* LWG 81171.

POLYPODIACEAE Berchtold et J. S. Presl
Lepisorus (J. Sm.) Ching

L. thunbergianus (Kaulf.) Ching, Bull. Fan Mem. Inst. Biol. Bot. 4:88. 1933. *Pleopeltis linearis* Thunb., Bedd. Handb. Ferns Brit. Ind. 346. 1883 (p.p.)

Common epiphyte, occasionally forming dense patches on moist rocks: *P. & S. Chandra,* LWG 81166.

Schellolepis J. Smith

S. subauriculata (Bl.) J. Sm., Ferns brit. and For. 82. 1866. *Goniophlebium subauriculatum* (Bl.) Bedd. Handb. Ferns Brit. Ind. 322. 1883.

Common epiphyte, in shaded humid places: *P. & S. Chandra,* LWG 81190.

Pyrrosia Mirbel

P. flocculosa (D. Don) Ching, Bull. Chin. Bot. Soc., 1:66. 1935; Nayar and Chandra in Bull. natn. bot. Gdns., no. 117:51. 1965.

Epiphyte with drooping fronds in evergreen forest: *P. & S. Chandra,* LWG 81168.

P. mannii (Gies.) Ching, Bull. Chin. Bot. Soc., 1:55. 1935; Nayar and Chandra in Bull. natn. bot. Gdns., no. 117:63. 1965.

An epiphyte (sometimes also on shaded rocks) in the primary forest: *P. & S. Chandra,* LWG 81158, 81164.

P. mollis (Kze.) Ching, Bull. Chin. Bot. Soc., 1:53. 1935; Nayar and Chandra in Bull. natn. bot. Gdns., no. 117:67. 1965.

Commonly met with on shaded rocks and seldom on trees as an epiphyte: *P. & S. Chandra,* LWG 81175.

P. obovata (Bl.) Ching, Bull. Chin. Bot. Soc., 1:47. 1935; Nayar and Chandra in Bull. natn. bot. Gdns., no. 117:76. 1965.

Abundant at low altitudes up to 750 m: *P. & S. Chandra,* LWG 81153.

P. subfurfuracea (Hook.) Ching, Bull. Chin. Bot. Soc., 1:68. 1935; Nayar and Chandra in Bull. natn. bot. Gdns., no. 117:83. 1965.

Epiphyte on tree trunks: *P. & S. Chandra,* LWG 81158.

P. varia (Kaulf.) Farwell. Amer. Midland Natur. 12:302. 1931; Nayar and Chandra in Bull. natn. bot. Gdns., no. 117:87. 1965.

Occasional on rocks, walls etc. at 150 m: *P. & S. Chandra,* LWG 81163.

Microsorium Link

M. membranaceum (D. Don) Ching, Bull. Fan Mem. Inst. Biol. Bot. 4:309. 1933; Nayar in Bull. natn bot. Gdns., no. 58:17. 1962.

A common epiphyte or lithophyte in moist and damp places, forming dense patches throughout the valley: *P. & S. Chandra,* LWG 81170.

M. pteropus (Bl.) Copel., Univ. Calif. Publ. Bot. 16:112. 1929. *Pleopeltis pteropus* (Bl.) var. *minor* Bedd., Bedd. Handb. Ferns Brit. Ind. 361. 1883.

Frequently seen on rocks on the bed and sides of streams:*P. & S. Chandra,* LWG 81155.

M. punctatum (Linn.) Copel., Univ. Calif. Publ. Bot., 16:111. 1929; Nayar in Bull. natn. bot. Gdns., no. 58:19. 1961.

Exceedingly common, growing either as an epiphyte or a lithophyte at 800 m: *P. & S. Chandra,* LWG 81173.

Colysis Presl

C. elliptica (Thunb.) Ching, Bull. Fan Mem. Inst. Biol. Bot., 4:333. 1933. *Selliguea elliptica* Thunb., Bedd. Handb. Ferns Brit. Ind. 392. 1883.

Terrestrial, quite rare: *P. & S. Chandra,* LWG 81156.

Dendroglossa Presl

D. minutula (Fee) Copel., Gen. Fil. 199. 1947. *Gymnopteris minus* Mett., Bedd. Handb. Ferns Brit. Ind. 430. 1883.

On sandy riverbeds, quite rare: *P. & S. Chandra,* LWG 81159.

Drynaria (Bory) J. Sm.

D. propinqua (Wall. ex Mett.) J. Sm., Hook., Jour. Bot., 4:61. 1842; Nayar in Bull. natn. bot. Gdns. 56:9. 1961.

Profusely on tree trunks or on moss covered rocks: *P. & S. Chandra,* LWG 81167.

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NATIONAL BOTANICAL RESEARCH INSTITUTE,
LUCKNOW 226 001,
August 12, 1981.

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GAGE, A. T. (1899): A botanical tour in the South Lushai Hills. *Rec. Bot. Surv. India. 1*(12): 331-369.

30. A NEW TAXON OF THE RUBIACEAE FROM NORTH EAST INDIA

(*With two text-figures*)

In course of studies on taxonomic revision of Indian *Psychotria* L. (Rubiaceae) we examined several specimens which could not be placed under the known taxa and appeared to be distinct. The present paper is based on such a collection

Psychotria silhetensis Hook. f. Fl. Brit. Ind. 3:174. 1880 is based on a collection from Sylhet by De Silva which is extant in *Wall. Cat.* 8336C (K—W, Photo in CAL!). A specimen bearing the same number in CAL, however, does not represent this taxon.

In course of Abor Expedition, I. H. Burkill collected a specimen *I. H. Burkill* 35726 (CAL) in fruiting condition from Makum, Assam in Nov. 1911. He assigned it doubtfully to *P. silhetensis.* G. Panigrahi collected a similar specimen (*G. Panigrahi* 11251) in Nov. 1957 from Dulong Reserve Forest, Assam. This is also in similar fruiting condition and collected from a locality near the former one. These were provisionally considered to form a new variety of *P. silhetensis.*

While these studies were going on, the late K. M. Vaid of Forest Research Institute, Dehra Dun, sent several specimens to the senior author for determination, one of which *K. N. Vaid* and *H. B. Naithani* 156 represented this new taxon.

On further study of all the material of *P. silhetensis* and those of the new taxon and in consideration of their distribution we assign these material to a new subspecies. Specimens available bear leaves with stipules, fruits with seeds and persistent calyx. This is described below.

Psychotria silhetensis Hook. f. subsp. **tomentosa** subsp. nov. (Fig. 1).

differt a *P. silhetensis* Hook. f. subsp. *silhetensis* foliis infra ferrugineo tomentosis, stipulis infra et secus marginem pubescentibus, fructibusque parvioribus ovoides.

This differs from *P. silhetensis* Hook. f. subsp. *silhetensis* in having leaves ferruginous tomentose beneath, stipules pubescent beneath and along the margin and smaller broadly ovoid fruit.

Shrubs 1.5 – 2 m high; branches stout, thick, quadrangular when young, terete in age, ferruginous tomentose. *Leaves* petiolate, 15 – 24 x 7 – 9 cm, elliptic or slightly elliptic-obovate, shortly acuminate at the apex, entire, cuneate or obtuse at the base, coriaceous, glabrous above, densely ferruginous tomentose beneath; midrib stout beneath, less so above, lateral nerves 14 – 20 on each side, subparallel, arcuate, close, conspicuous beneath, less so above; axil of the midrib and lateral nerves imperforate; nervules reticulate conspicuous beneath, less so above; petioles 1 – 1.5 cm long, thick, tomentose; stipules deciduous, 1.5 – 2.5 x 0.6 – 0.7 cm, ovate, caudate-acu-

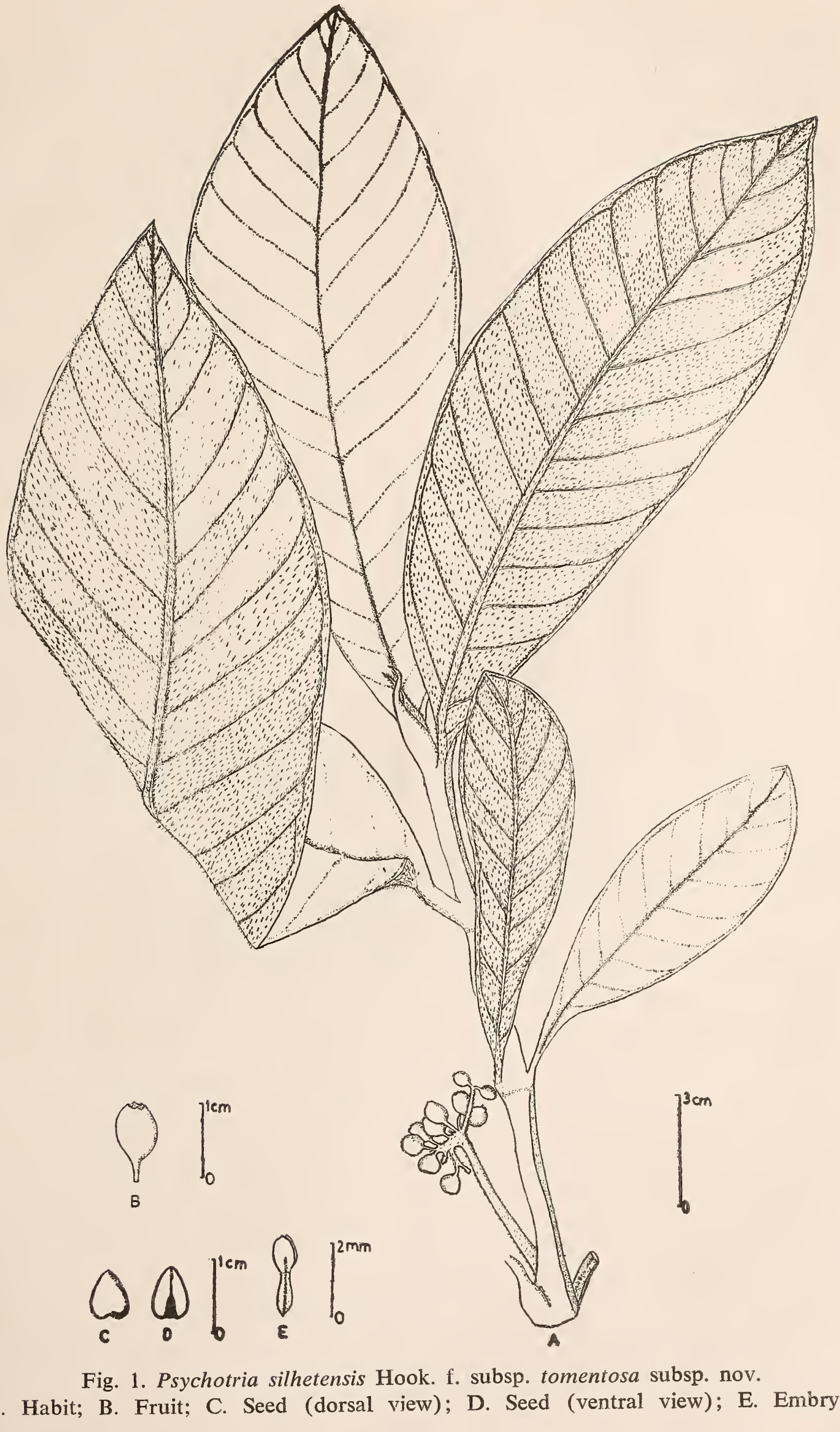
1cm
0
B
3cm
0
1cm
0
2mm
0
C
D
E
A

Fig. 1. *Psychotria silhetensis* Hook. f. subsp. *tomentosa* subsp. nov.
A. Habit; B. Fruit; C. Seed (dorsal view); D. Seed (ventral view); E. Embryo.

minate, coriaceous, glabrous above, pubescent beneath and along the margin. *Inflorescence* terminal or axillary, long peduncled cymes, 5 – 8 x 2 – 8 cm (when fruiting), branches irregular or dichotomous, short or spreading, stout, tomentose; bracteoles minute. *Flowers* not available. *Fruits* 0.5 – 0.6 x 0.3 – 0.45 cm, subglobose, crowned with calyx (lobes triangular, about 0.05 cm long, ciliate at the margin), glabrescent, shortly stalked; stalks 0.3 – 0.5 cm; pyrenes solitary, ovoid, plano-convex, acute at the apex, retuse at the base, smooth, thin walled. *Seeds* 0.4 – 0.5 x 0.3 – 0.4 cm, ovoid, acute at the apex, retuse at the base, dorsally convex, smooth, with a longitudinal shallow groove on the ventral side; albumen uniform, thick; micropyle pointing upwards; cotyledons fleshy, oblong.

Type: Assam, North Lakhimpur, Makum, 21-11-1911, *I. H. Burkill* 35726 (Holotype in CAL). North Lakhimpur, Dulong Reserve Forest, 21-11-1957, *G. Panigrahi* 11251 (Paratype in CAL); Arunachal, Deomali, *K. N. Vaid and H. B. Naithani* 156 (Paratype in DD).

Distribution: Makum and Dulong Reserve Forest of North Lakhimpur district, Assam to Deomali Reserve Forest of Tirap district, Arunachal.

It is worthwhile to note the distribution of the typical subspecies *P. silhetensis* Hook. f. subsp. *silhetensis* which is as follows. *Sylhet* (Bangladesh), Khasi Hills, North Cachar, Mizoram, Manipur, Nagaland, Sibsagar district and Dafla Hill of Arunachal Pradesh.

Distinct distribution of these two subspecies is clearly evident from the accompanying map (Fig. 2).

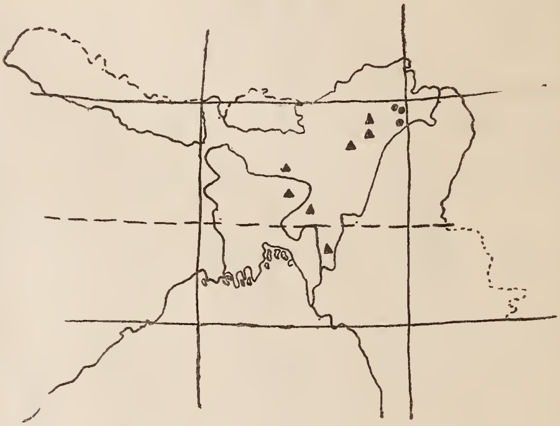

Fig. 2. Distribution of *Psychotria* silhetensis Hook. f.
▲ *P. silhetensis* Hook. f. subsp. *silhetensis.*
● *P. silhetensis* Hook. f. subsp. *tomentosa.*

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Grateful thanks are due to Dr S. K. Jain, Director, Botanical Survey of India for granting a scholarship to the junior author.

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BOTANICAL SURVEY OF INDIA,
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1983 DECEMBER Vol. 80 No. 3

ECOLOGICAL ADAPTATION IN RHESUS MONKEYS AT THE KUMAON HIMALAYA[1]

KAZUO WADA[2]

(*With a plate and nine text-figures*)

In the western Kumaon Himalayas, the distributional range of Rhesus monkeys comprises two major habitat types coniferous forest dominated by *Cedrus deodara, Pinus roxburghii* and *Pinus wallichiana,* and terrace fields with potatoes, wheat, maize and peas. In the hill areas the troops always include fields as feeding places in their home ranges. During winter, as food variety decreases, the monkeys take to the seeds of pine tree as stapie food. The monkey troops tend to travel to the lower part of the home range to avoid heavy snowfall, and then exploit the terrace fields more frequently than at other seasons. This is due to the scarcity of foods in the forests. It seems likely that in winter the Rhesus monkeys live milder environmental conditions than the Japanese monkeys. When some troops join and separate again at the lower elevation home ranges, there was little antagonistic behaviour. Eight categories of grouping were distinguished in the troop. Females with babies to 3-yr-olds are sociologically the basic group males which occupy the rear of troop procession function as defenders.

INTRODUCTION

Ecological and Sociological studies on the Rhesus monkey (*Macaca mulatta*) have been actively carried out in the Indian Subcontinent. Two types of ecological studies can be distinguished. Southwick, Beg & Siddiqi (1961a & b), Mukherjee & Mukherjee (1972), and Siddiqi & Southwick (1977) concentrated on the population ecology of the troop composition and troop density at the roadside or in streets, while Neville (1968), Lindburg (1971, 1976), Makwana (1978), Teas *et al.* (1980), and Koyama & Shekar (1981) studied the general ecology, focussing on the troop composition, distribution, home range and habits. Neville

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[1] Accepted July 1981.

[2] Primate Research Institute, Kyoto University, Inuyama City, Aichi, Japan.

and Lindburg dealt with changes in troop movements and food habits related to the seasonal variations in habits of the monkeys, but little attention was given to the relation between the vertical distribution of the forest zones and that of the monkeys.

Within the genus *Macaca,* the Rhesus monkey and the Japanese monkey represent species which are adapted to areas of heavy snowfall and cold winters. The Rhesus monkey shows the next most northerly distribution to the Japanese monkey and, vertically, it reaches the snowfall areas of the Himalayas. Its distribution which spreads over a large spectrum of habitats, is the widest among macaques.

I believe it is possible to show that, in the evolutionary process of expansion of *Macaca,* this monkey successfully occupied new habitats. Important in this respect, is the Rhesus monkeys' reaction to the habitat destruction brought about by human influences, and to man himself.

The present study represents the first attempt to clarify the mode of life of the Rhesus monkey from the above viewpoints.

METHODS

The survey areas included Simla, Narkanda and Sungri in Himachal Pradesh, and the road from Simla to Rampur. In the former case, data were collected periodically by direct observation of the monkeys and supplementary information was obtained from villagers. In the latter case, the data were based on mobile censuses from buses, short ground-surveys and information from the local inhabitants. Both study areas are situated in the lower Himalayas of western Kumaon (Fig. 1). The survey period covered 6 months from August, 1972. Eleven specimens of Rhesus monkeys were collected at Sungri with the cooperation of Mr. K. L. Mehta, wildlife warden of Himachal Pradesh, for research on their geographical variation.

GENERAL HABITAT OF THE RHESUS MONKEYS

The lower Himalayas, at 2,000-3,000 m above sea level (a.s.l.), lie in the transitional zone to the Great Himalayas, and are affected by monsoons. Based on a personal communication from Mr. K. L. Mehta, the annual rainfall in Simla is 2,168 mm. However, at the upper limit of the monkey distribution, it decreases to 1,757 mm, with 50% of the precipitation occurring during July and September. Snowfalls in the same areas begin in late November, but are concentrated during December and February. It appears that snowfalls in Khadrala which is very near and at the same height as Sungri, are more frequent than in Simla since the amount of precipitation in Khadrala somewhat exceeds that in Simla (Table 1).

Terrace fields occur up to 2,600 m a.s.l. in the survey areas, forming the upper boundary of cultivation. Below this boundary, terrace fields occupied the greatest area except on the steep slopes of valleys, and in the forest reserve covering water sheds for the drinking water of Simla at Kufri, probably amounting to 40% of the total survey area.

The survey areas were occupied by coniferous forest. This was generally dominated by *Pinus,* which extended continuously in its vertical distribution, although in some forests *Cedrus deodara* and *Abies* were dominant. *Picea, Juniperus,* and *Taxus* were found sporadically in the forests.

The genus *Pinus* was represented by *P. roxburghii* and *P. wallichiana.* Their distribution ranges were 500-2,200 m a.s.l. and 2,000-3,000 m a.s.l., respectively (Fig. 2). In the survey areas, *Pinus*-dominated forests were especially well developed on southern slopes, as indicated previously by Stainton (1972).

Evergreen broad-leaved forests in which

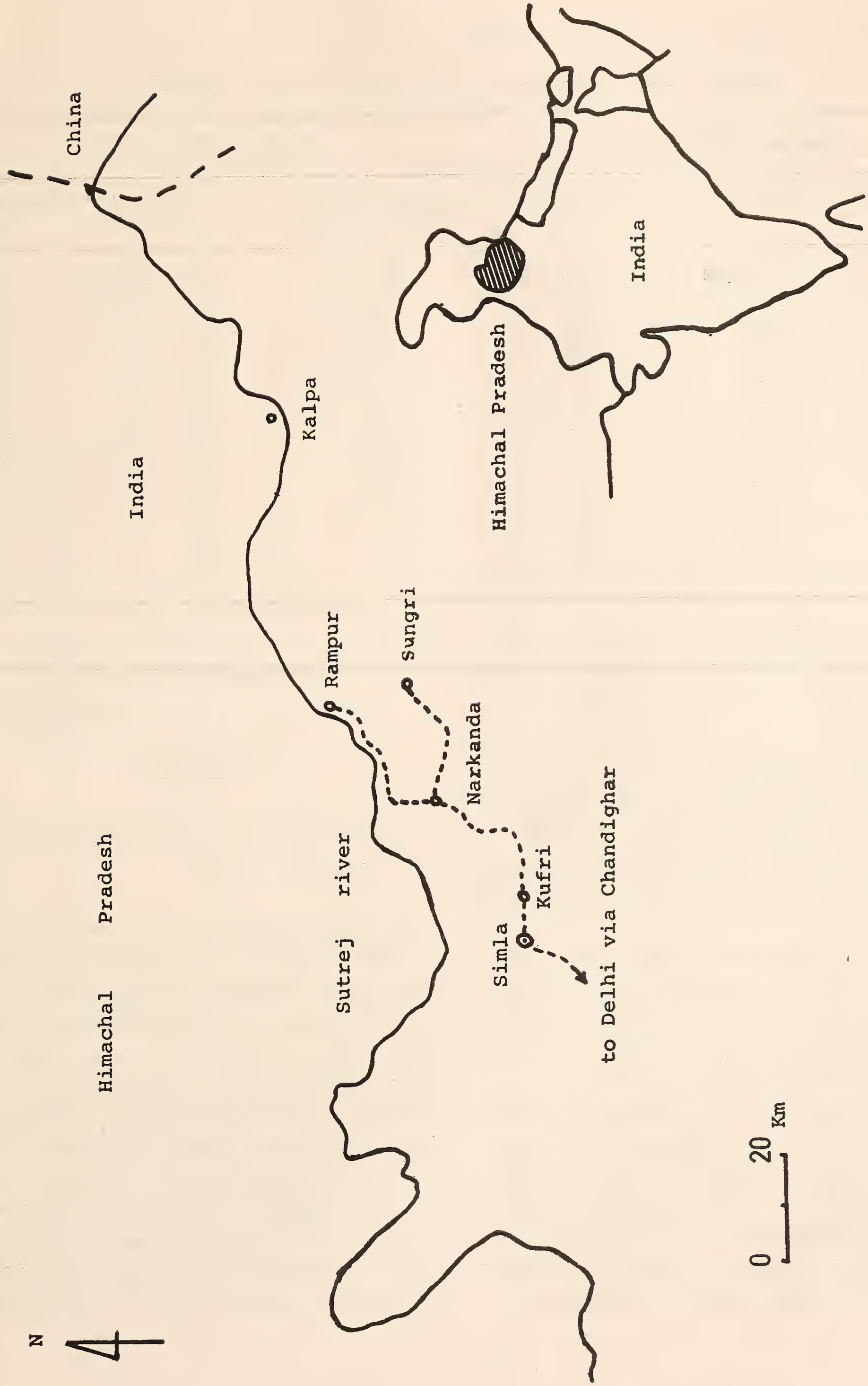

China
India
Kalpa
Himachal Pradesh
Rampur
Sungri
Narkanda
Kufri
Simla
to Delhi via Chandighar
Sutrej river
Himachal Pradesh
India
N
0
20
Km

Fig. 1. Map of survey areas.

TABLE 1

MONTHLY MEAN RAINFALL IN SIMLA AND KHADRALA, 1951-1960

	Khadrala (2,600 m a.s.l.)		Simla (2,000 m a.s.l.)		
	Rainfall amount	No. of days rainfall	Rainfall amount	Mean air temperature max.	min.
Jan.	213.4 mm	6.6 days	66.3 mm	23.6°C	1.9°C
Feb.	93.2	4.8	74.2	9.3	2.3
Mar.	121.2	0.6	59.9	13.9	6.4
Apr.	70.9	0.4	46.0	18.4	10.3
May	88.4	—	64.3	22.9	13.9
Jun.	89.4	—	153.4	23.9	15.9
Jul.	384.6	—	414.0	21.6	15.1
Aug.	321.1	—	428.0	20.2	15.1
Sep.	166.9	—	423.7	20.2	13.5
Oct.	77.5	—	299.7	17.9	12.3
Nov.	13.0	0.6	132.3	14.6	6.8
Dec.	116.6	2.2	6.1	17.8	9.7
Total	1,756.7		2,168.0		

(after K. L. Mehta)

Quercus were dominant, occurred as large patches in the coniferous forest zone. The vertical distribution of species was as follows: *Quercus glauca* below 1,500 m a.s.l., *Q. incana* at 1,500-2,000 m, and *Q. semecarpifolia* at 2,000-3,000 m.

Deciduous broad-leaved trees were found sporadically as forest constituents in the above-mentioned forests. The species included *Betula alnoides, Aesculus indica, Robinia pseudoacacia, Pyrus pashia, Rosa sericea,* etc.

All these forests were utilized as grazing grounds for cattle, sheep and goats. The forest undergrowth was severely reduced by grazing and stamping, and the scrub layer was poorly developed. Observation of the monkeys was thus easy under the forest canopy, the visibility and general working conditions being good.

RESULTS

The Rhesus monkey distribution and forest-cropland complex

In Simla, Kufri, Narkanda, Sungri and Rampur, where direct observations and collecting of encounter information were carried out, and along the roadside between Simla and Rampur, where rough observations were made from buses, monkey troops are continuously distributed. Around Simla, Kufri, Narkanda and Sungri, the home range of a troop includes both types of habitats, i.e., cultivated terrace and forest (Figs. 3, 4 and 5). Rhesus monkeys were never found in large forest patches such as the Gren Forest in Simla (*Quercus*-dominated), the coniferous forest of the southern

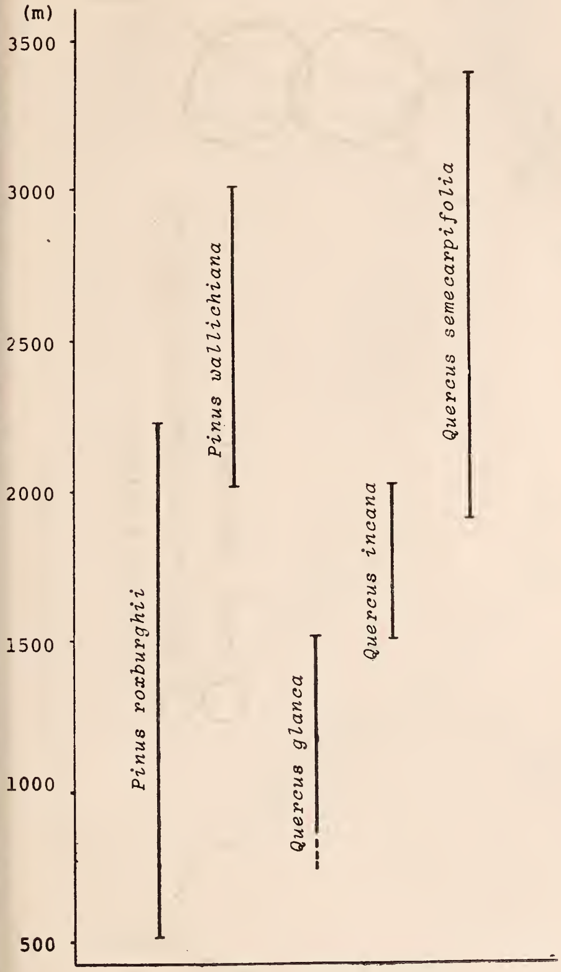


Fig. 2. Vertical distribution of pine and oak in the survey area.

slope at Kufri, and the huge coniferous forest of the northern slope at Sungri.

The upper limit of the monkey distribution coincides with the upper border of crop cultivation. In both Narkanda and Sungri, the upper border of crop fields reaches 2,600 m a.s.l., and monkey troops ranged up to 2,600 m, appearing in terrace fields at intervals and feeding on the crops. The forest zone goes up to 3,300 m on the southern slopes of Murali Danda, 3 km north-east of Sungri. In this area of increasing elevation, *Quercus semecarpifolia* is continued and *Abies* and *Picea* are gradually mixed into *Pinus*-dominated forest, but this change in composition does not affect the monkey distribution.

The population size in each village is at the level of several hundreds; The villagers never supply monkeys with food, and the monkeys do not approach village houses to search the kitchen middens. Simla (population 200,000) is situated on a narrow ridge running north-east to south-west at 1,550-2,000 m a.s.l., and is surrounded by *Pinus roxburghii*-dominated and *Quercus semecarpifolia*-dominated forests, which are favourable habitats for Rhesus monkeys. The township of Simla is 4 km long and 1 km wide. Ten monkey troops travel around temple gardens, markets and hospitals without utilizing the surrounding forest patches, so their home ranges were confined to the streets of Simla (Fig. 6).

Activity pattern of troops

Generally, Rhesus monkeys take many kinds of crops in terrace fields and other cultivated fields in India (Neville 1968, Mukherjee 1969). The times spent in the two areas were 78% in forests and 22% in fields (Table 2). However, remarkable differences were noted in the number of hours that the troop stayed in the fields among the survey areas. These differences depend upon the farmers' attitude.

To simplify the description of ecologically important individual activities, I classified their activities into 7 categories: Moving, feeding, sitting, grooming, playing, mounting and quarrelling.

In terrace fields: Almost all individuals of each troop except in Simla and Kufri were

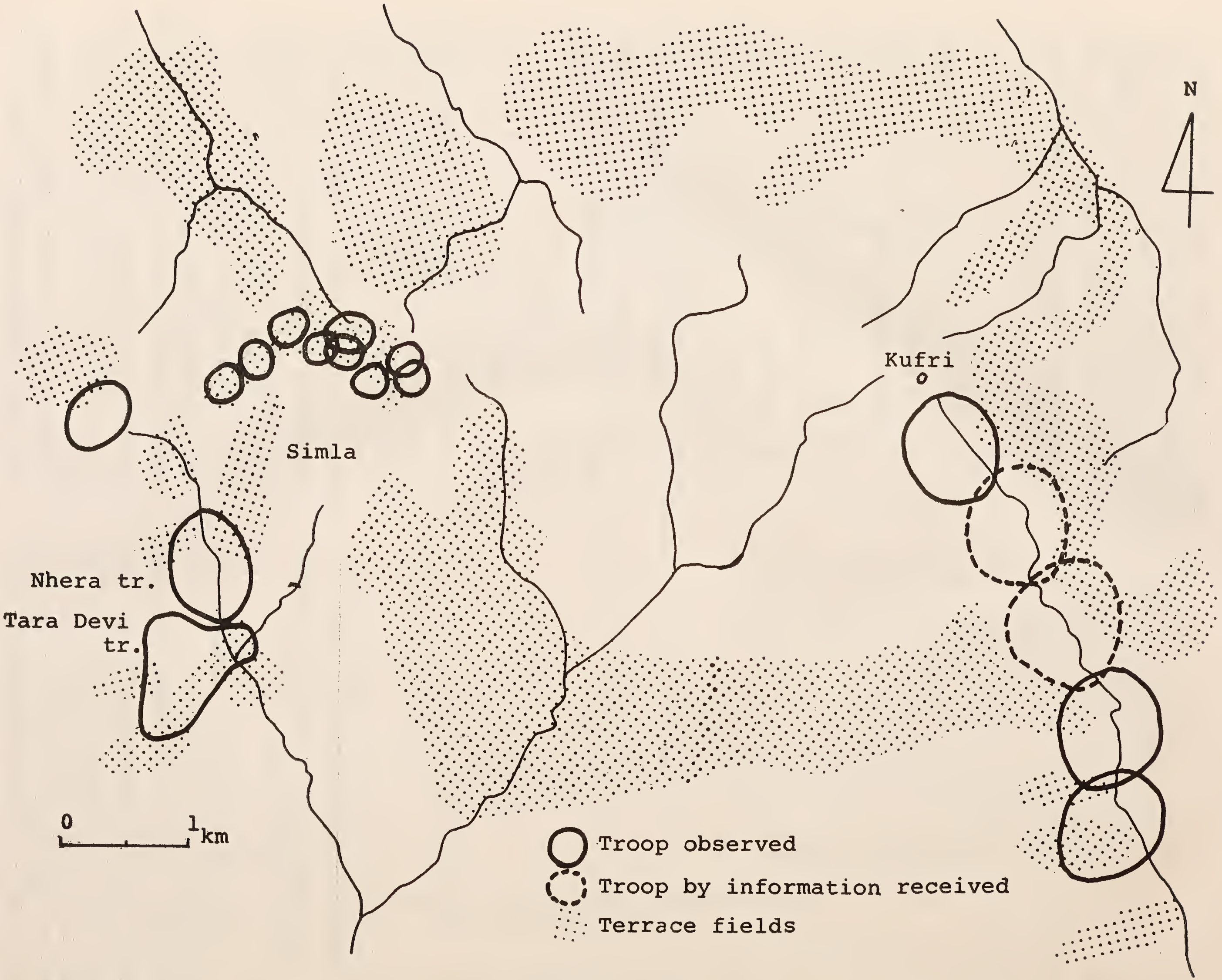

N
Kufri
Simla
Nhera tr.
Tara Devi tr.
0
1 km
Troop observed
Troop by information received
Terrace fields

Fig. 3. Troop distribution at Simla.

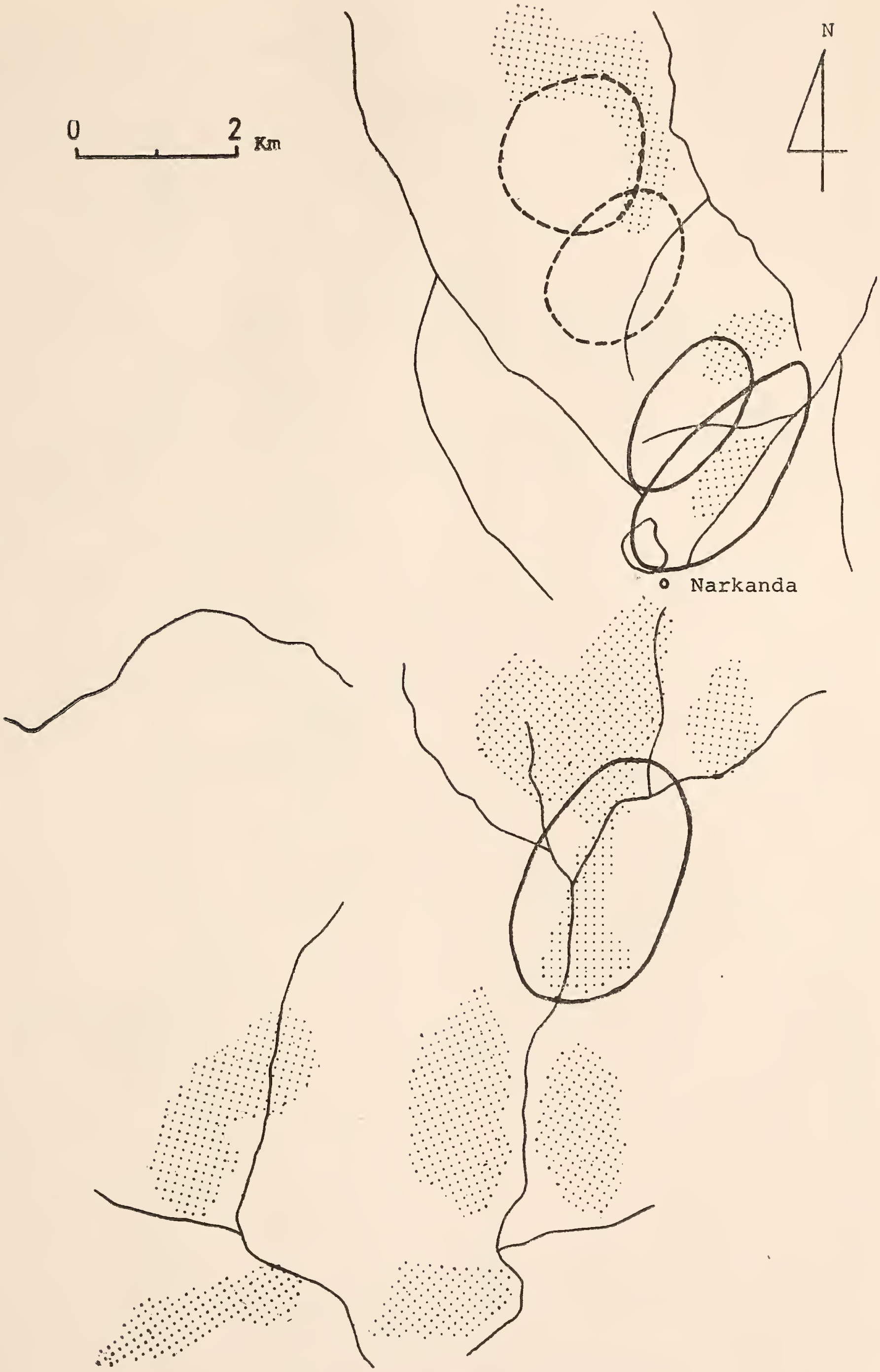

0
2 Km
N
Narkanda

Fig. 4. Troop distribution at Narkanda.

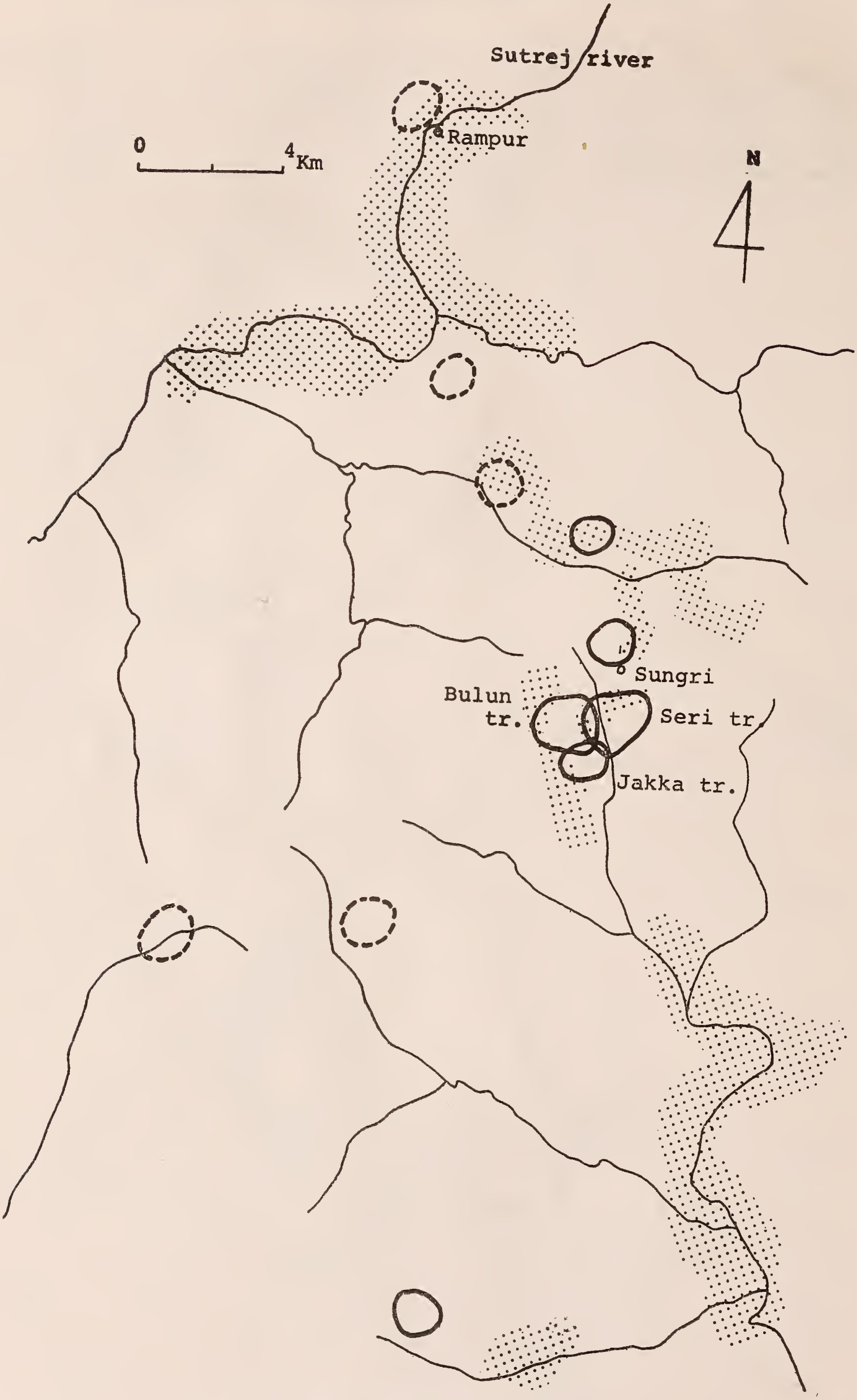

Sutrej river
Rampur
0
4 Km
N
Sungri
Bulun tr.
Seri tr.
Jakka tr.

Fig. 5. Troop distribution at Sungri.

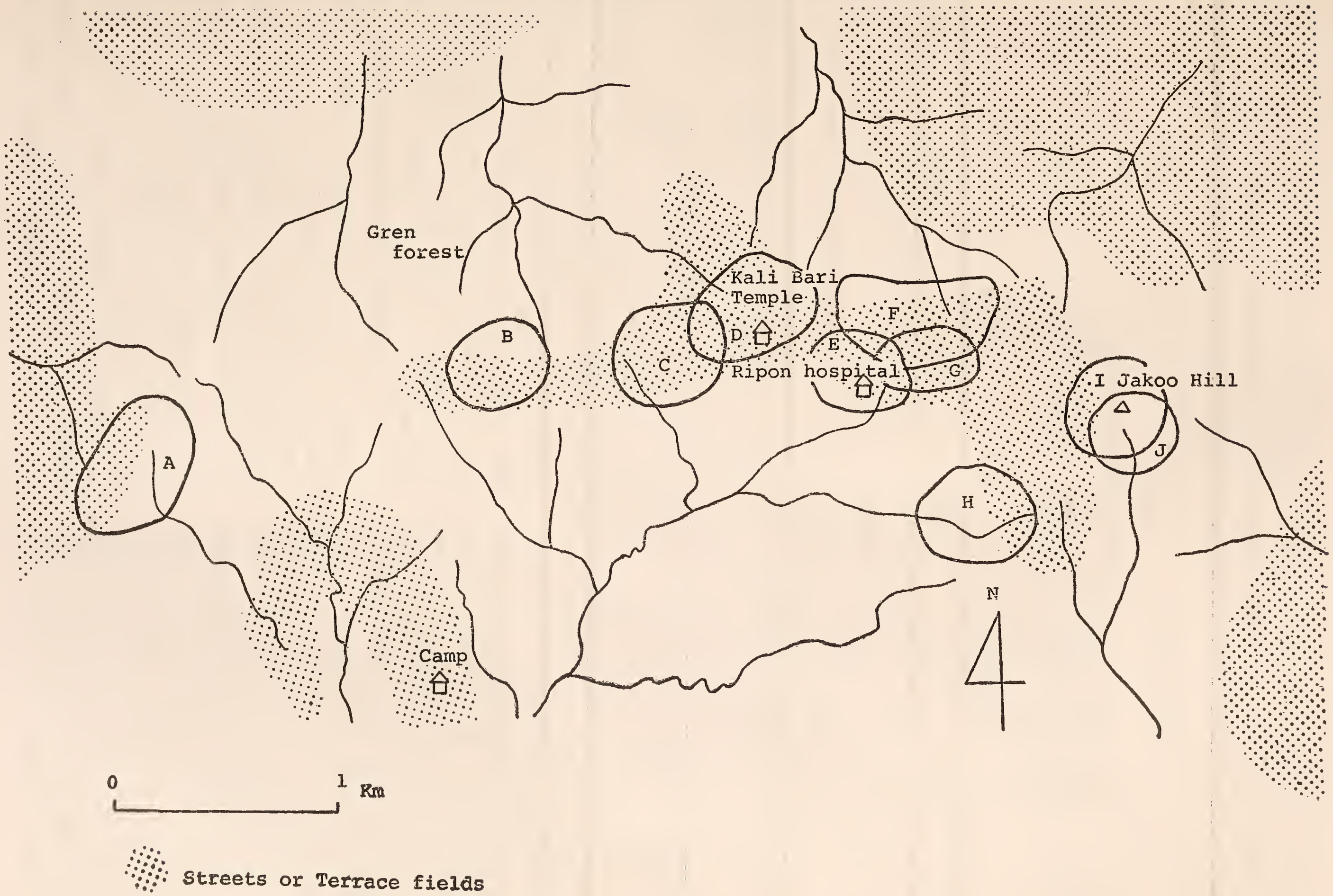

Gren forest
Kali Bari Temple
Ripon hospital
I Jakoo Hill
A
B
C
D
E
F
G
H
J
Camp
N
0
1 Km
Streets or Terrace fields

Fig. 6. Troop distribution in and around Simla.
A: Bioleaugang troop; B: Cecil troop; C: Assembly troop; D: Kali Bali Temple troop; E: Ripon Hospital troop; F: Ridge troop; G: Lower Bazar troop; H: View troop; I: Jakoo Temple I troop; J: Jakoo Temple II troop.

TABLE 2

UTILIZATION OF THE MONKEY TROOPS IN FORESTS AND TERRACE FIELDS

Area	Period observed	Observation time (hr)			Days observed
		Total	In forests	In fields	
Simla and Kufri	Sept, 1972 — Jan, 1973	20.3	20.3	0	22
Narkanda	Sept, 1972 — Dec, 1972	60.4	53.5	6.9	14
Sungri	Oct, 1972 — Jan, 1973	79.5	50.4	29.1	17
	Oct, 1972 — Dec, 1972	39.6	33.0	6.6	
	Jan, 1973	39.9	17.4	22.5	
Total		160.2	124.2	36.0	46

TABLE 3

ACTIVITY PERCENTAGE OF RHESUS MONKEYS IN TERRACE FIELDS

	Sitting	Grooming	Mounting	Moving	Feeding	Playing	Quarrelling	Number of ind. observed
Simla & Kufri	0%	0%	0%	0%	0%	0%	0%	0
Narkanda	2.1	4.5	0.8	15.7	76.4	0.4	0	242
Sungri	10.6	6.9	0.3	34.1	47.1	0.7	0.3	1371
Total	9.2	6.5	0.4	31.4	51.5	0.7	0.3	1613

counted in terrace fields. Monkey troops spent most of the time feeding in the terrace fields. Because the troops were not chased away from the fields by farmers or dogs in Sungri, they spent the remainder of the time moving, sitting and grooming in the fields (Table 3).

The individuals of a troop did not spread out in terrace fields where there were watchmen. Adult animals picked up food, e.g., corn, in the fields and usually returned immediately to the forest fringe to eat slowly. In the fields where there were no watchmen, the members of the monkey troop spread out in the fields without disturbance, keeping the original spacing among individuals, so in some cases adult females, babies and juveniles appeared in the fields from the top group of a troop. They gradually spread throughout the fields without indications of tension or fear. When farmers approached to within 20 m they ran into the forest, but remained near the edge of the forest canopy. When the farmers left, they usually returned to the fields again.

There are differences in farmers' attitudes to chasing the monkeys, depending on the kind of crop. Corn is rigorously protected, followed by peas and buckwheat, but autumn sown wheat and potatoes are almost neglected. Corresponding to the farmers' interest, the Rhesus monkeys behave in different ways in the fields according to the nature of the crop. They are tense when they forage for corn, but are at ease when foraging for autumn sown wheat or potatoes, etc. In Nhera village and Mulong village near Simla the corn harvest was little damaged by the monkeys, being kept effectively under watch. In Dhalar village and in Nheri village near Narkanda, waste potatoes after the harvest and wheat were the main targets of the monkeys' foraging. Along the main paths of movement of the troops throughout Dhalar village and Nheri village (Narkanda) and Tikkri village, Balun village and Sunmarkot village (Sungri), the troops probably caused little harvest damage because they spread out and rested in the fields, and picked young leaves of autumn sown wheat.

The frequency of appearance in the terrace fields increased remarkably in winter in relation to the snowfall. This point will be discussed later.

Although children at times threw stones to the monkeys, people in Simla do not chase Rhesus monkeys, because of religious sentiments. In the streets of Simla, people sometimes gave food to monkeys, but continuous provisioning is practised only for the troops at Jakoo Temple and Kali Bali Temple. Other troops forage mostly at dumping grounds, in grasslands or in small thickets in gardens.

In forests: More than 60% of all troop members were recorded every observation time. Out of 124 hr observation in forests, feeding accounted for 26.9% of the total activities (Table 4).

TABLE 4

ACTIVITY PERCENTAGE OF RHESUS MONKEYS IN FORESTS

	Sitting	Grooming	Mounting	Moving	Feeding	Playing	Quarrelling	Number of ind. observed
Simla & Kufri	16.4%	3.7%	0 %	48.3%	28.1%	1.7%	1.7%	402
Narkanda	10.5	7.6	1.4	43.5	33.4	2.3	1.4	740
Sungri	8.8	8.6	1.6	56.2	21.7	0.6	2.6	1025
Total	10.8	7.3	1.2	50.4	26.9	1.4	2.0	2167

Judging from these tables, the amount of feeding was presumed to be greater in the fields than in the forests. However, it is not yet known whether differences exist between feeding ability in forests and feeding in fields.

Food list of Rhesus monkeys

The main food in the forests consisted of fruits, nuts, seeds, leaves and stems of various trees and grasses. Seeds of trees such as *Pinus roxburghii*, *P. wallichiana*, leaves of *Berberis aristata*, leaves and stems of *Trifolium repens* comprised the staple food during the survey period, but fruits of *Vitis himalayana* are eaten during October and November. Fruits and leaves of *Quercus incana* and *Q. semecarpifolia*, and fruits, leaves, stems and grains of plants were substaple or temporary food. Table 5 shows the main food items and their utilization. The trees and the grasses that comprise the staple foods were the most common species in the home ranges of the troops. Lindburg (1976) described the foods of 92 species in the tropical forest, and that the staple foods are composed of common species in the forest.

TABLE 5

FOOD LIST OF RHESUS MONKEYS

Feeding area	Kind of food	Family	Part eaten	Frequency of eating	Period as staple food
Forest	*Pinus roxburghii*	Pinaceae	Seed	Extremely often	Sept.-Jan.
	Pinus wallichiana	Pinaceae	Seed, Leaf	Extremely often	Sept.-Jan.
	Cedrus deodara	Pinaceae	Leaf	Rarely	
	Quercus incana	Fagaceae	Fruit, Leaf	Frequently	
	Quercus semecarpifolia	Fagaceae	Fruit	Frequently	
	Prunus cornuta	Rosaceae	Fruit	Frequently	
	Osyris arborea	Cornaceae	Fruit	Rarely	
	Rosa moschatta	Rosaceae	Fruit	Frequently	
	Cotoneaster affinis var. *basillaris*	Rosaceae	Fruit	Rarely	
	Reinwardtia trigyna	Linaceae	Leaf	Frequently	
	Berberis aristata	Berberidaceae	Leaf	Very often	Sept.-Jan.
	Syringa sp.	Oleaceae	Fruit	Frequently	
	Tilia europaea	Tiliaceae	Fruit	Rarely	
	Tiliaceae		Bark	Rarely	
	Ficus sarmentosa	Moraceae	Fruit	Frequently	
	Vitis himalayana	Vitaceae	Fruit	Extremely often	Oct.-Nov.
	Trifolium repens	Leguminosae	Stem, Leaf	Extremely often	Sept.-Jan.
	Rumex crispus	Polygonaceae	Leaf	Frequently	
	Rumex acetosa	Polygonaceae	Leaf	Frequently	
	Fragalia nubicola	Rosaceae	Stem, Leaf	Frequently	
	Duchesnea indica	Rosaceae	Stem, Leaf	Frequently	
	Stellaria media	Caryophyllaceae	Leaf	Frequently	
	Poa anna	Gramineae	Stem, Leaf	Frequently	
	Sarcococca saligna	Buxaceae	Fruit	Frequently	
	Trichosanthes sp.	Cucurbitaceae	Leaf	Rarely	
	Pimpinella diversifolia	Umbelliferae	Leaf	Rarely	
	Umbelliferae		Leaf	Rarely	
	Plantago lanceolata	Plantaginaceae	Leaf	Rarely	
	Compositae		Leaf	Frequently	
	Vicia sativa	Vicieae	Leaf	Frequently	
	Jasminum humile	Oleaceae	Leaf	Rarely	
	Bothriochloa glabra	Poaceae	Grain	Frequently	
	Arundinella setosa	Poaceae	Grain	Frequently	
	Pteridium aquilinum	Pteridaceae	Leaf	Rarely	
Fields	Buckwheat		Grain	Rarely	
	Peas		Pod	Rarely	
	Corn		Grain	Extremely often	Aug.-Sept.
	Potatoes		Root	Extremely often	Oct.-Nov.
	Wheat		Young leaf	Extremely often	Nov.-Jan.
	Apples		Fruit	Rarely	
	Pumpkins		Fruit	Rarely	
	Beans			Frequently	
Streets	Leavings of inhabitants			Extremely often	Sept.-Jan.
	Fruit and vegetables			Frequently	
	Rice and chapati			Rarely	
	Meat and egg				

Rhesus monkeys in the fields ate fruits, grains and roots of crops, and the leaves of autumn sown wheat. All kinds of crops cultivated in the home ranges were eaten. Corn, potato, and wheat, which were the most commonly cultivated crops were most utilized by the monkeys.

In the streets, Rhesus monkeys picked up fruits, vegetables, rice, and the remains of chapatis. Many people visiting the Jakoo Temple and the Kali Bali Temple offer dried beans, biscuits and fruits haphazardly. The amount of food given to monkeys in the temples is possibly less than that given to the Japanese monkeys which are so provisioned. Furthermore, only a few individuals can obtain food. The monkeys living in the streets eat mainly leaves and seeds of *Pinus wallichiana,* fruits of *Quercus incana,* leaves of *Rumex* sp., *Stellaria media,* grains of the Gramineae, and certain kinds of vines.

The Lower Bazar troop, the Ripon Hospital troop, and the Boileauganj troop live mainly on remnants of human food, and the Jakoo Temple troops and the Ridge troop are mainly dependent on trees and grasses in groves and gardens.

Troop size, distribution of Rhesus monkeys

The Tara Devi troop and the Nhera troop (Fig. 3), like troops in Narkanda and Sungri, contain more than 30 individuals, whereas the troops in the Simla streets, except for the Jakoo Temple I and II troops, contained less than 30 individuals (Table 6). Therefore, the sizes of troops in natural habitats were bigger than those of troops in the Simla streets, except for the Jakoo Temple I and II troops. The Jakoo troops occupy *Cedrus deodara*-dominated forests around this temple, so that environ-

TABLE 6

TROOP SIZE OF RHESUS MONKEYS

Area	Troop	No. of individuals	Kinds of habitat
Simla	Tara Devi	33	Forests and fields
	Nhera	20–25	,,
	Jakoo Temple I	49	Forests along streets
	Jakoo Temple II	44	,,
	Ridge	30	Streets
	Lower Bazar	*c* 20	,,
	Rippon Hospital	15	,,
	Assembry	26	,,
	Karivali Temple	*c* 30	,,
	Cecil	15	,,
	Boileauganj	8	,,
	View	4	,,
Narkanda	Dosa	37	Forests and fields
	Nheri	36	,,
Sungri	Seri	46	Forests and fields
	Balun	50	,,
	Jakka	37	,,

mental conditions are different compared to those of troops in the streets. Furthermore, these two troops obtained diverse foods from people visiting the temple. The other troops living in the streets could not get food from people, but foraged in domestic refuse and other items around Simla.

The home range of the ten troops in the Simla streets (4 km x 1 km) overlapped widely and avoided the *Quercus incana*-dominated and *Pinus roxburghii*-dominated forests near the streets (Fig. 6). On the other hand, troops having fields and forests as home ranges were continuously distributed so that the home ranges were in contact, and sometimes overlapped (Figs. 3, 4 and 5).

The size of the 7 troops occupying forest and field averaged 37.4 individuals, ranging from 23 to 50.

Forests and terrace fields in the home range

The boundary of the home range was defined as the line connecting the outermost travelling routes. The sizes of the home ranges in Narkanda and Sungri were observed over comparatively long periods, it was difficult to

TABLE 7

SIZE OF THE HOME RANGE OF TROOPS

Area	Troop	Maximum diameter of home range (km)	Home range (km²)			
			Forest	Field	Total	per ind.
Simla	Tara Devi	2.0				
	Nhera	2.6				
	Jakoo Temple I	<0.5				
	Jakoo Temple II	,,				
	View	,,				
	Ridge	,,				
	Lower Bazar	,,				
	Rippon Hospital	,,				
	Kalivali Temple	,,				
	Mall	,,				
	Cecil	,,				
	Boileauganj	,,				
Kufri	Swaya	2.4				
	Nara	2.3				
	Bagna	,,				
	Vahila	,,				
Narkanda	Nheri	2.1	1.0	0.5	1.5	0.04
	Doza	1.3	0.5	0.1	0.6	0.02
	Deolidhar	2.6				
Sungri	Seri	3.0	1.7	0.7	2.4	0.05
	Balun	3.4	3.4	1.3	2.6	0.05
	Jakka	c3.0				

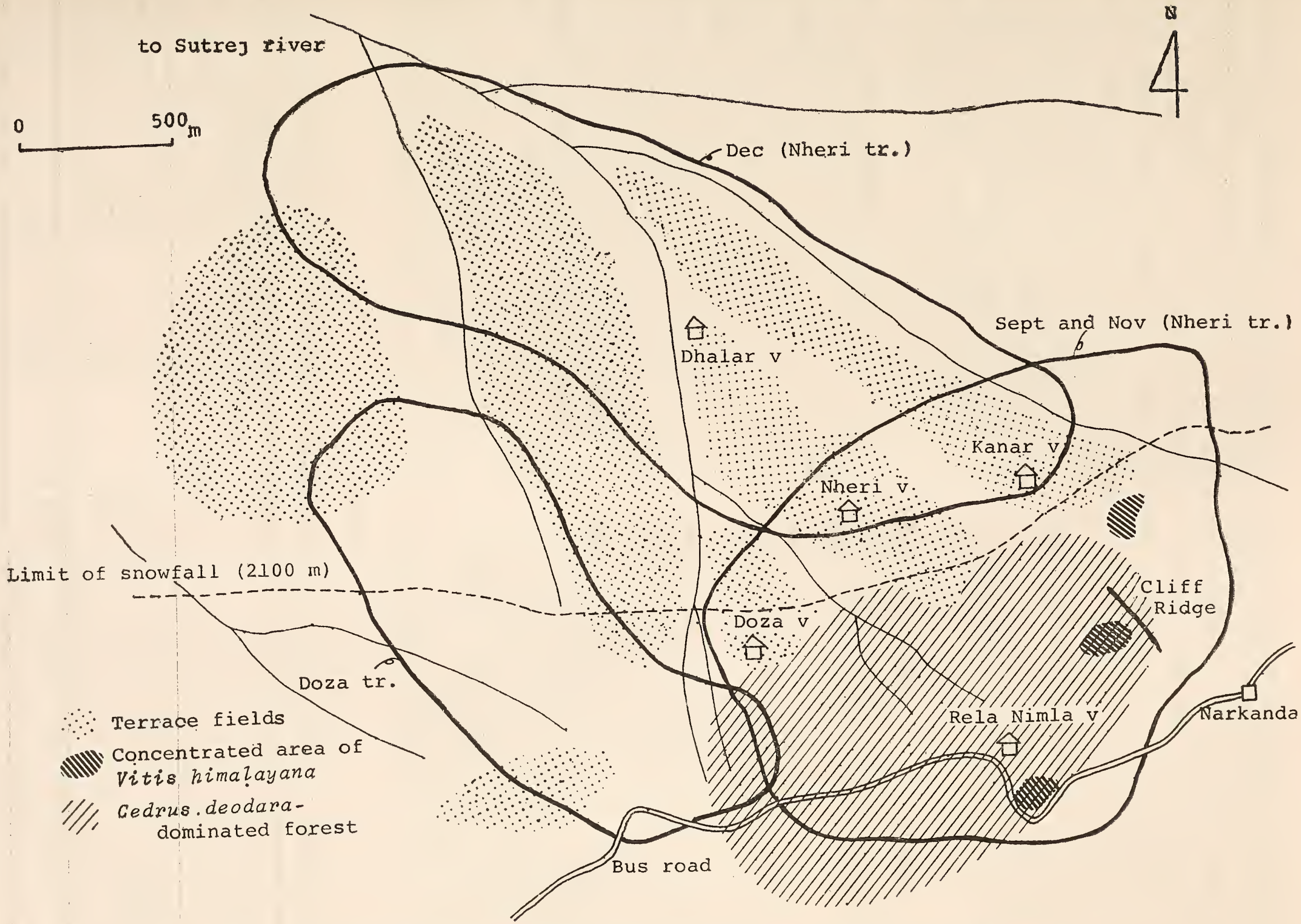

N
to Sutrej river
0
500 m
Dec (Nheri tr.)
Sept and Nov (Nheri tr.)
Dhalar v
Kanar v
Nheri v
Limit of snowfall (2100 m)
Cliff
Ridge
Doza v
Doza tr.
Rela Nimla v
Narkanda
Terrace fields
Concentrated area of
Vitis himalayana
Cedrus deodara-
dominated forest
Bus road

Fig. 7. Seasonal changes in utilization within the home range of the troops at Narkanda.

trace both troops in Sungri separately in January, so their separate status could not help declining. But it was possible to determine the size in other areas. In the latter cases, the maximum diameter of the home range was measured instead of the area (Table 7). Home ranges in Narkanda were smaller than at Sungri, but more extended observations might have reduced the difference.

Terrace fields accounted for 29%-50% of the home range, and are important as feeding areas.

In comparison, monkey troops in Simla moved little, presumably because the troop were dependent on kitchen midden, groves and gardens.

Changes of home range of Rhesus monkeys, and food and snowfall

In Narkanda: The troop movements changed depending on the presence of ripe fruits in the forests in autumn. In coniferous forests between Nheri village and Narkanda street (2,200-2,500 m a.s.l.) there were three places where clusters of *Vitis himalayana* grow together with coniferous trees, i.e., opposite Rela Nimla, near the cliff ridge, and in the upper part of Kanar village (Fig. 7).

Fruits of *Vitis himalayana* ripen fully in Narkanda from mid-September to the end of October. I observed monkeys in mid-September and in early October in that area. At this season, the Nheri troop used the area above the road lying beneath Nheri village and intensively utilized the coniferous forest beyond Nheri village. The above-mentioned clusters of *Vitis himalayana* were included within their daily travelling course. Although I was informed that the troops appeared in corn, potato, and pea fields around Nheri village, the troops chiefly utilized food in forests during this period.

The leaves of trees gradually start to turn yellow in early October, and broad-leaved trees and most of the undergrowth are defoliated at the end of October. At the same time, fruits of *Vitis himalayana* fall. As a result, food variability becomes low, and the kind of food available decreases. Seeds of *Pinus wallichiana*, fruits of *Quercus semecarpifolia*, and *Rosa moschatta*, and certain other trees, leaves and stems of *Trifolium repens*, and leaves of the Gramineae were eaten remarkably. All these plants covered the whole home range of the Nheri troop.

At the end of November and the end of December, the Nheri troop travelled around Nheri village and Dhalar village, situated down-

TABLE 8

UTILIZATION RATES OF FORESTS AND TERRACE FIELDS IN THE HOME RANGE OF THE NHERI-DOZA TROOPS

Survey period	Utilized amount of home range (hr)			
	Forests	Fields	Total	Troop
Sept.-Oct., 1972	29.0	0	29.0	Nheri troop
Nov.-Dec., 1972	15.3	6.4	21.7	„
Dec., 1972	9.2	0.6	9.8	Dosa troop
Total	53.5	7.0	60.5	

Table 9

Snowfall data for Simla, Narkanda and Sungri

Date	Snowfall amount		
	Simla	Narkanda	Sungri
1972	Nov. 24, rainstorm	Nov. 24, snowfall 20 cm	Nov. 24, snowfall
		Nov. 25-29, snow remaining on southern slopes	
		early Dec., snowfall	Dec. 9, snowfall 40 cm
			Dec. 10-12, snow remaining on southern slopes
		Dec. 19, snowfall 30 cm	Dec. 19, snowfall 40 cm
		Dec. 28, snowfall 30 cm	
1973	Jan. 7, rainfall	early Jan., snowfall	Jan. 8-9, snowfall 20 cm
	mid-Jan. snowfall	mid-Jan., snowfall	Jan. 12, snowstorm 60 cm
			Jan. 18, snowfall 10 cm
		end of Jan., snowfall	Jan. 20, snowfall 40 cm
	Jan. 27, snowfall 20 cm		

(observed by Wada)

stream from Nheri village. At this season, the variety of food decreased as already mentioned, and the duration of stay in the terrace fields increased greatly (Table 8). Although the monkey troop partly utilized the fields as a home range in September and October, it moved chiefly in the forests. However, by the end of November the troop spent most of its time in the fields, and sometimes remained in the same field without being chased by farmers or dogs, as seen on 29th November. In this season, potatoes were harvested, but considerable amounts of left-overs remained in the fields, while the autumn sown wheat was about 20 cm long in sporadic distribution between Nheri village and Dhalar village.

The main food sources of the Rhesus monkeys in this season in the terrace fields were potato remnants and leaves of autumn sown wheat. All individuals of the troop spread over all parts of the fields in seeking these food items.

Snowfall was recorded 10 times from November to January, 1972-1973 (Table 9). There was about 20 cm snowfall above 2,200 m a.s.l. on 24th November, but it rained below that altitude. This snowfall remained for 6 days, and subsequently, unwithered *Trifolium repens,* and seeds of *Pinus wallichiana* were again exposed.

The Doza troop was observed at the end of December. This troop usually moved along the western ridge of Doza village utilizing the *Pinus wallichiana*-dominated forests without entering the terrace fields (Figs. 4 and 7). The home range of this troop lies between 2,000 m a.s.l. and 2,400 m a.s.l., where snow falls. Going straight down from the ridge, it touches the home range of the Nheri troop around Dhalar village. At the end of December, the Doza troop was travelling only in the forests,

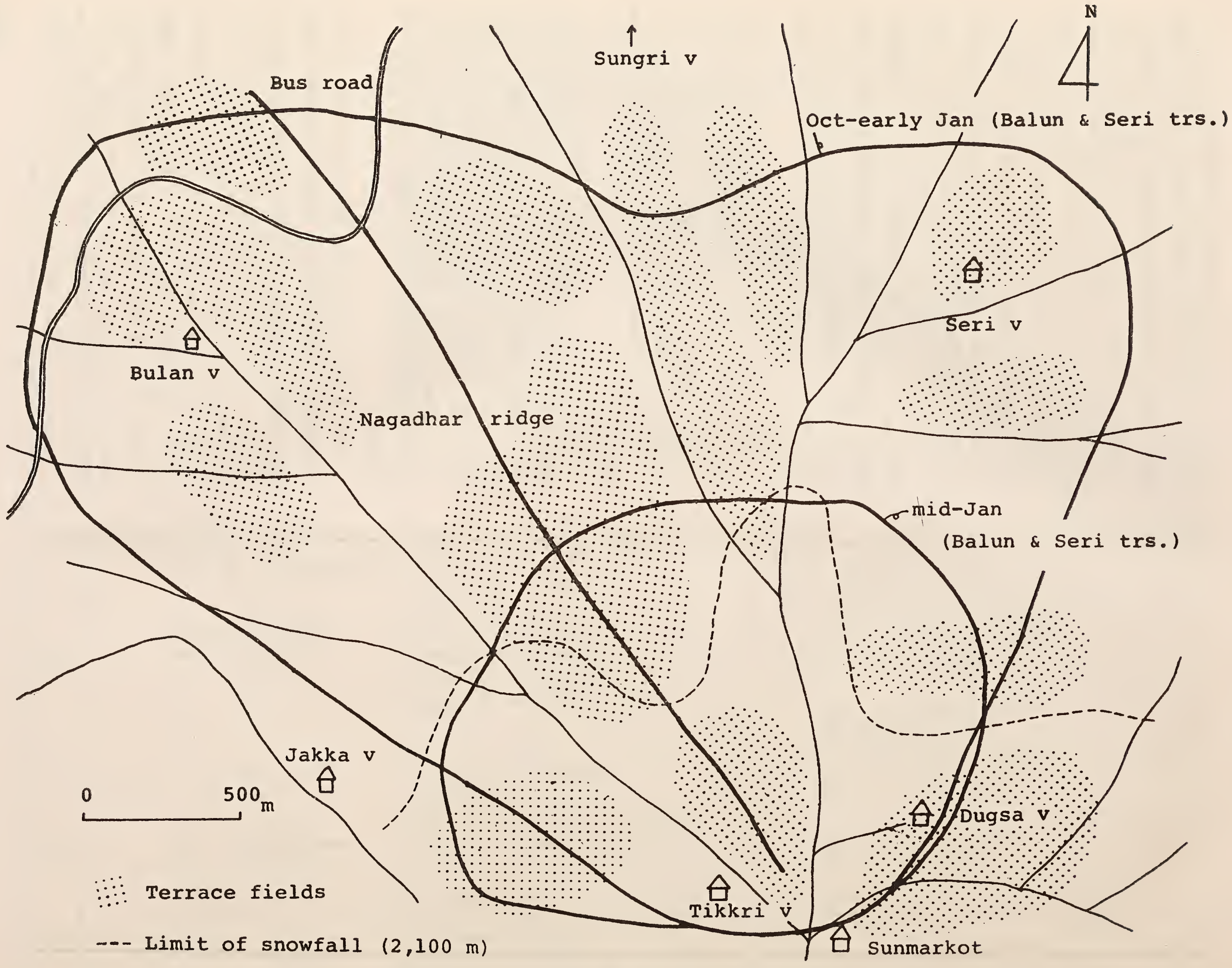

N
Sungri v
Bus road
Oct-early Jan (Balun & Seri trs.)
Seri v
Bulan v
Nagadhar ridge
mid-Jan
(Balun & Seri trs.)
Jakka v
0
500 m
Dugsa v
Tikkri v
Sunmarkot
Terrace fields
--- Limit of snowfall (2,100 m)

Fig. 8. Seasonal changes in utilization within the home range of the troops at Sungri.

indicating that the forests offer an adequate supply of food for the troop, contrary to the case of the Nheri troop. These findings reflect differences between the forest types of the two ranges: Deodar-dominated forests wiith little *Pinus wallichiana* in the Nheri troop range, and *Pinus wallichiana*-dominated forests in the Doza troop range.

In Sungri: There are differences in the utilization of home ranges between October-December and January, judging from 4 periods of observation of the Balun troop and the Seri troop during the end of October, mid-November, mid-December and mid-January. During the period between October and December, they travelled in the area between Balun village and Seri village; the lowest point reached was Sunmarkot, and the highest was near the Simla-Bhali road (Figs. 5 and 8).

The Balun troop travelled in the area of Balun village and along the Nagadhar ridge at the beginning of January and the Seri troop travelled in the area of Seri village at the same time. Since the middle of January in the survey area troops were not found. So it is sure that the Balun and Seri troops travelled near Tikkri village and Dugsa village during the middle of January, and the third troop (Jakka troop) was found at 16th January near Tikkri village, so that 3 troops utilized the area from around Tikkri village to Dugsa village, having overlapping home ranges (Fig. 8).

During my observation period, the 2 troops used the upper part of their home ranges in October-December, and the lower part in January.

The numbers of snowy days and the duration and amount of snowfall in Sungri were almost the same as those in Narkanda, which is situated at the same altitude. In Sungri, it snowed about 10 times during the period between November and the end of January, and the time during which snow remained on the ground increased gradually. The remaining snow on the southern slopes melted within 3 or 4 days in November or December, but in January snow fell very often, so that the ground was fully covered. The snowfall on 8th, 12th, 18th and 20th January resulted in persistent snow cover above Balun village and Seri village during January. In this respect, the snowfall in January is different from that in November and December.

The Balun troop and the Seri troop chiefly travelled around Balun village and Seri village in November and December, and changed their home ranges to the region of Tikkri village and Dugsa village in January. This change in home range appeared to be related to the snowfall in these areas. They concentrated around Tikkri village and Dugsa village, where there was no snowfall in January, while higher regions were covered with snow.

Snow cover on the ground affects the movement pattern of the monkeys by changing food availability. Food items during October-December were the seeds of *Pinus wallichiana,* both on the ground and in pine cones, as well as nuts and fruits of other kinds of trees, the leaves and stems of *Trifolium repens,* many kinds of grasses in the forests, remaining potatoes and young leaves of autumn sown wheat in the terrace fields. After heavy snow, only the seeds of *Pinus wallichiana* in the forest canopy remained available. One or two days after snowfall in October-December, exposed areas in the forests and the ridges of fields became clear of snow and the monkeys obtained food in such places. Since the amount and frequency of snowfall increased in January, finding food on the ground became difficult. The monkeys therefore utilized the lower part of the home range, where there were potatoes and young leaves of autumn sown wheat in

TABLE 10

DAILY TRAVEL DISTANCE OF TROOPS

in Simla			in Narkanda			in Sungri		
Date	Troop	Distance (km)	Date	Troop	Distance (km)	Date	Troop	Distance (km)
Sept., 24, 1972	Tara Devi	2.2	Sept., 18, 1972	Nheri	2.2	Dec., 8, 1972	Balun	0.4
,, , 25,	,,	3.1	,, , 20	,,	1.6	,, , 9	,,	0.7
Oct., 22, 1972	Nhera	0	Oct., 5, 1972	,,	1.7	,, , 10	,,	0.6
,, , 25,	,,	1.6	,, , 6	,,	1.1	,, , 11	,,	0.8
,, , 26,	,,	0.7	Nov., 27, 1972	,,	0	,, , 12	Seri	1.6
Dec., 24, 1972	,,	0.2	,, , 28	,,	1.0	,, , 12	Balun	1.4
Jan., 25, 1973	,,	0	,, , 29	,,	2.0	,, , 13	Seri	0.9
			,, , 30	,,	2.4	,, , 13	Balun	1.0
			Dec., 1, 1972	,,	0.8	,, , 14	Seri	4.6
			,, , 22	,,	1.0	,, , 14	Balun	1.0
			,, , 23	,,	1.0	Jan., 10, 1972	,,	1.5
			,, , 24	,,	1.8	,, , 11	,,	1.3
			,, , 27	Doza	1.6	,, , 12	,,	0.4
			,, , 28	Nheri	1.1	,, , 13	,,	1.5
			,, , 30	,,	1.2	,, , 14	,,	1.1
			,, , 31	Doza	1.1	,, , 15	,,	0.8
			,, , 31	Nheri	0.7	,, , 16	B	0.9
						,, , 16	A	0.7
						,, , 16	Jakka	0.8
						,, , 17	B	1.4
						,, , 19	E	0.8

the fields, and the seeds of *P. wallichiana,* leaves of *Berberis aristata* and stems and leaves of *Trifolium repens* in the forests, avoiding the snow-covered regions in the upper part of the range.

Differences in the movement pattern of the troop appear to be related to changes in the utilization rate of the fields and the forests. The time spent by the troops in the fields and in the forests from October to December were quite different from those in January. In the period between October and December, 83.3% of the total observation time was spent in the forests and 16.7% in the fields. However, in January, only 48.4% was spent in the forests and the remaining 51.6% in the fields. There was a marked increase in the utilization of the terrace fields.

The daily travel distance of a troop was not affected by snowfall (Table 10). Footprints of monkeys in the snow immediately after snowfall were less than 20 cm deep, so the abdomen did not touch the snow surface.

In Narkanda and Sungri, the troops changed their utilization areas to below the lowest limit of snowfall after frequent snowfalls. This indicates that such a change in home range is due to difficulty in obtaining food in the presence of snow cover rather than to the low temperature or the difficulty of moving in the snow.

Before snowfalls, the troop utilized the upper part of the home range, where the members usually foraged the fruits of *Vitis himalayana,* which is abundant near Narkanda, and the seeds of *Pinus wallichiana* in Sungri.

After snowfall, the troops descended below the lower limit of snowfall and foraged the seeds of *Pinus wallichiana* on the ground, *Trifolium repens,* potato remnants and young leaves of wheat. Because of forest area was relatively small in the lower part of the home range compared to the upper part around Narkanda or Sungri, the degree of dependence on the terrace fields became much higher.

As mentioned above, Rhesus monkeys travelled out of snow-covered areas, and so their travel distance and feeding behaviour were not influenced directly by snowfall. They avoided the worst conditions of snowfall in their habitat by changing the areas of utilization within the home range.

Intertroop relationships

In the survey areas, troops of Rhesus monkeys are distributed almost continuously, but each troop has its own home range. Here I describe the contact between troops, and the joining and parting of troops which travelled together for several days.

Intertroop relations were observed in Sungri on 12th December, 1972, and 16th, 17th and 19th January, 1973 (Fig. 9).

Observation 1 (12th December, 1972, at Nagadhar ridge):

Nagadhar ridge is in the home range of the Balun troop. On the 11th December the Balun troop was observed in the upper part of the ridge where it roosted in two groups separated by about 1 km. On the 12th, the troop was found in the place where it has spent the previous night, and then it moved slowly to the east, and appeared in the terrace fields beyond the Nagadhar ridge. This troop was composed of 96 individuals. Divided into 2 parts by the attack of a dog, 46 individuals escaped to the east, and 50 individuals to the west. The troop split very quickly, without confusion. The 46 individuals which went to the east travelled slowly for two days around Seri and Dugsa villages. On the other hand, the remaining 50 individuals stayed in the upper part of the forest around Balun village. It is almost certain that the group of 50 individuals is the Balun

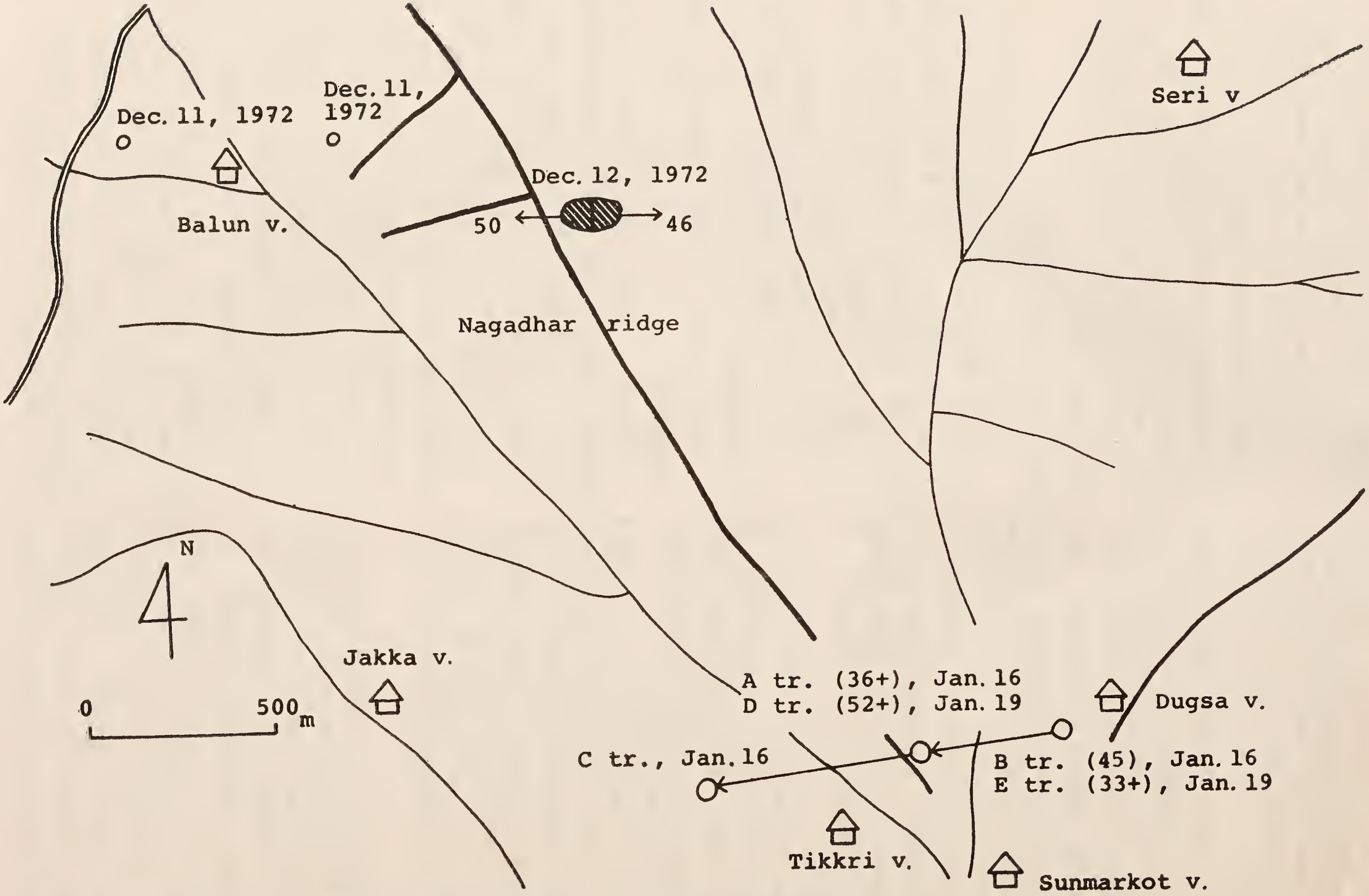

Dec. 11, 1972
Dec. 11, 1972
Balun v.
Dec. 12, 1972
50
46
Nagadhar ridge
Seri v
N
0
500 m
Jakka v.
A tr. (36+), Jan. 16
D tr. (52+), Jan. 19
C tr., Jan. 16
B tr. (45), Jan. 16
E tr. (33+), Jan. 19
Dugsa v.
Tikkri v.
Sunmarkot v.

Fig. 9. Joining and dividing of troops at Sungri.

troop, which contained 68 individuals at maximum and that the other group of 46 individuals was the Seri troop.

Observation 2 (16th January, 1973 at Tikkri village):

Forty-five individuals (B troop) were found in the terrace fields near Tikkri village on 15th January, and they travelled to the vicinity of Dugsa village. On the following day, 45 individuals were found in the forest directly below Dugsa village, and 36+α individuals (A troop) in the fields of Tikkri village. The B troop began to travel to the fields of Tikkri village, following the same course that it had taken the previous day. The top group of the travelling troop was composed of two adult females, one 1-yr-old and one 2-yr-old, and they approached the central part of the A troop, which was spread out in the fields. Hereupon, 8 adults in the central part of the A troop moved about 5 m toward high ground. Following them, the A troop started to move slowly to the upper part of the ridge, and the B troop followed the A troop. Both troops travelled about 1 km in 5 hr after joining: for 1.5 hr out of the 5 hr, the distance between the 2 troops was only 10 m.

Before the A troop met the B troop, the A troop may have been foraging in the terrace fields near Tikkri village with the C troop (Jakka troop), because footprints in the snow on the night of the 15th were traced along that line, and the C troop was observed 500 m away travelling slowly in the direction of Jakka village immediately after the joining of the A and B troops.

Thus, the movement of the 3 troops appeared to have been as follows: on the night of 15th the A and Jakka troops joined in the fields near Tikkri village and travelled together until the morning of the 16th. Immediately after parting from the Jakka troop, the A troop joined the B troop. They travelled together all day long and roosted in the same place.

Observation 3 (19th January, 1973 at Tikkri village):

On 17th January, 45 individuals were found around Tikkri village, and 47 individuals around Dugsa village. On the following day, it was reported that both troops were around Dugsa village and Tikkri village at the same time.

On 19th January, 33+α individuals (E troop) from Dugsa village crossed a brook and approached 52+α individuals (D troop) in the fields near Tikkri village. This situation was exactly the same as the relation between the A and B troops on 16th January, i.e., moving to the terrace fields near Tikkri village along the same route that was taken on the 16th from the wheat fields below Dugsa village, the E troop approached the D troop, which was foraging in the fields. Three juveniles of the D troop (3- to 5-yr-old) attacked individuals of the E troop which were climbing the slope at a distance of 15 m with "Ga, Ga, Ga" calls. The top group of the E troop was composed of an adult female, 1-yr-old, 3-yr-old and an adult male, and 33+α individuals of the E troop joined the D troop. There was no trouble during the contact between the 2 troops, and 86 individuals were eating together in the fields for about 3 hr.

When I observed the A.B.D.E. troops, no other troops were found in the survey area except the Jakka troop. It suggests that the 4 troops correspond to the Seri and Balun troops.

From the above-mentioned observations, the following conclusions can be drawn: 1) Some troops travelled together during certain periods, 2) When joined troops moved together, the individuals from each troop were not mixed but retained their identity as separate troops, 3) In the coming together of troops, there was little antagonistic behaviour and 4) Converging of several troops occurred in early winter when snow cover was present for short periods, and occurred again more frequently when monkey troops moved to lower utilization areas after snowfall. As autumn sown wheat fields and potato fields were only seen around the Tikkri-Dugsa-Sunmarkot villages at low altitude, the monkey troops gathered in these limited areas and the chance of troop meetings increased.

Grouping through troop procession

Rhesus monkey troops are composed of individuals of both sexes and of all ages; the composition is very similar to that of the Japanese monkey troop. One small group of 3 adult males was found at Sungri, but continuity of the group was not observed.

The observation of individual groupings within the troop was limited to count of individuals crossing streamlets or spreading out in the terrace fields.

A) The grouping of troop processions: the number of individuals of a troop, its composition by sex and age, and its grouping structure were observed 14 times (Table 11). When troops were moving across forest slopes with feeding, they usually moved slowly with individuals scattering. However, when crossing streamlets, as in case 9, 12-14 of Table 11, all individuals of the troop usually moved simultaneously and rapidly for a short period along the same route. Since there were pauses among moving monkeys, it was possible to distinguish groups roughly. In all these cases the monkeys moved in several compact groups.

The grouping combination which occurred most frequently consisted of adult males and adult females with babies up to 3-yr-olds, accounting for 39% of all groupings. Juveniles were estimated at 4- to 6-yr-olds, and adults at 7-yr-old and over for both male and female. Babies in troop procession followed their mother closely, or clung to her back or abdomen, while 1- to 3-yr-olds walked further away from their mothers. The position of adult males during troop movement varied.

Some 23% of the groupings consisted of adult females and babies to 3-yr-olds, and mothers were located at the center of groupings. The remaining 39% were as follows: 1) males only, 2) male and adult females, 3) juveniles of both sexes, 4) adult females and juveniles of both sexes, 5) adult females only, and 6) adult males and juveniles of both sexes.

Some features were noted in the order of individuals within each troop procession.

During rapid movement without feeding, the leading part of the procession was composed of adult males, adult females and babies to 3-yr-olds or adult females and babies to 3-yr-olds. In case 9, the top group consisted of a adult male with erect tail, 2 adult females with a baby, and 3-yr-olds. In case 13, adult females and babies to 2-yr-olds formed the top group. They crossed a rivulet and were the first to contact the A troop. Second and third groups without adult males crossed the rivulet, and then the tail-erecting adult male appeared 18 min after the top group had forded. At that time the top group had already joined the A troop. In case 12, the top group consisted of adult females and babies to 3-yr-olds.

It was not clear at which moment troops moved. However, when the troop had started to move, a male with erect tail in case 9, and a adult female in case 13 led troop orientation and the change of movement behavior.

The individuals consisting the top group during troop procession included two combinations: adult males, adult females and babies to 3-yr-olds, of adult females and babies to 3-yr-olds only. In the former case, the position of adult males in the group was not fixed.

Table 11. Procession composition at troop movement

No. of times	Date	Area observed	Troop	Grouping & Ind. no.	Ind. no.	Observed activity	Time (min)
○ 1	Nov. 29, 1972	Narkanda	Nheri	○ 22 ● 11	33	Moving	2
2	Dec. 30, 1972	"	Doza	● 5 ○ 6 X 2 X 1 ● 13	27	"	19
○ 3	Dec. 8, 1972	Sungri	Balun	○ 5 ◑ 3 ○ 11 X 1 ○ 8 X 1 ◐ 2	31	Moving and feeding	76
○ 4	Dec. 9, 1972	"	"	◐ 3 ○ 9 △ 1 ○ 26 □ 2 □ 1 ○ 4 ◐ 4 X 1	51	Moving	39
○ 5	"	"	"	○ 28 □ 1 ● 5 ○ 4 X 1 ◑ 2 ◐ 2	43	"	11
6	Dec. 10, 1972	"	"	○ 5 ● 4 ● 13 ○ 4	26	Moving and feeding	46
7	Dec. 12, 1972	"	Balun + Seri	■ 4 ● 2 X 1	96	"	66
8	"	"	Seri	○ 6 ○ 8 ◐ 2 ● 5 ○ 13	34	"	·65
○ 9	Dec. 13, 1973	"	"	○ 5 ○ 16 ○ 18 ◐ 2 ◐ 2	43	Moving	11
○ 10	Jan. 10, 1973	"	Balun	X 3	3	"	10
11	Jan. 15, 1973	"	"	○ 11 ● 8 ● 5	24	Moving and feeding	5
12	"	"	"	● 23 ○ 24	49	Moving	9
13	Jan. 16, 1973	"	B	● 8 ● 4 △ 1 ○ 11 ○ 21	45	"	18
14	Jan. 17, 1973	"	"	● 20 ● 5 ○ 6 ○ 14	45	"	8

○ Adult♂ + adult♀ + babies to 3-yr-olds
● Adult♀ + babies to 3-yr-olds
◑ Adult♀ + juveniles
○ Observation example exactly traced till last ind. of troop
X Adult♂ only
◐ Adult♂ + adult♀
△ Adult♀ only
□ Juveniles only
■ Adult♂ + juveniles or babies to 3-yr-olds

Adults estimated at more than 7-yr-olds
Juveniles estimated at 4- to 6-yr-olds

There were many adult males at the rear of troop processions. Among 8 examples observed in detail, a male with erect tail occupied the last position in one case. In 4 cases, a male and female pair occupied the rear position, and this may be related to the breeding season. Even if troop started to move, such pairs were slow to move, and as a result they remained in the last half of the troop procession.

In one example, 5 adult males occupied the rear of the troop procession with 21 individual groupings composed of adult males, adult females and babies to 3-yr-olds.

Therefore, the rear of troop processions consisted mainly of adult males in 6 out of 8 examples.

Once, the Doza troop was pursued and attacked by a medium-sized dog in the forests of Rela Nimla village near Narkanda. All the monkeys of the troop climbed into the canopy of *Pinus wallichiana* and ascended about 15 m from the dog. When the dog approached, a roughly 10-yr-old male stood on guard on the ground. He adopted a threatening posture with open mouth, but made no sound. The dog barked and approached within 10 m of the adult male. The animals faced each other in this way for several minutes. In the meantime, the other monkeys retreated. The adult male backed away slowly from the dog, in the direction of troop movement.

B) Groupings in a troop spread out in terrace fields: In all 18 cases, partial spacing of a troop was observed during feeding times. The most frequent groupings were adult females with babies to 2-yr-olds or adult males and adult females. In many cases adult males were solitary, but they did not quarrel even when converging into terrace fields with distances of 1-2 m between individuals.

The distribution changed according to the size of the fields or forests in which feeding occurred. In the narrow sections of *Pinus wallichiana* along the brook of Narkanda, troops picked up seeds of *Pinus wallichiana* in a 100 m line along the brook slope.

In small wheat fields, e.g., 20 m x 20 m in area, individuals ate with parts of their bodies in contact. When they were spreading out to eat potato remnants on terrace fields, they ate sporadically over an area of 20 m x 50 m (Plate).

In spite of the variation of habitat sizes, the feeding area of a troop was usually within 100 m in diameter, with individual distances depending on the sizes of the terrace fields or forests. Thus, individual spacing corresponds to the feeding environment.

Grouping of adult females with babies to 3-yr-olds most frequently appeared during troop procession or feeding (Table 11).

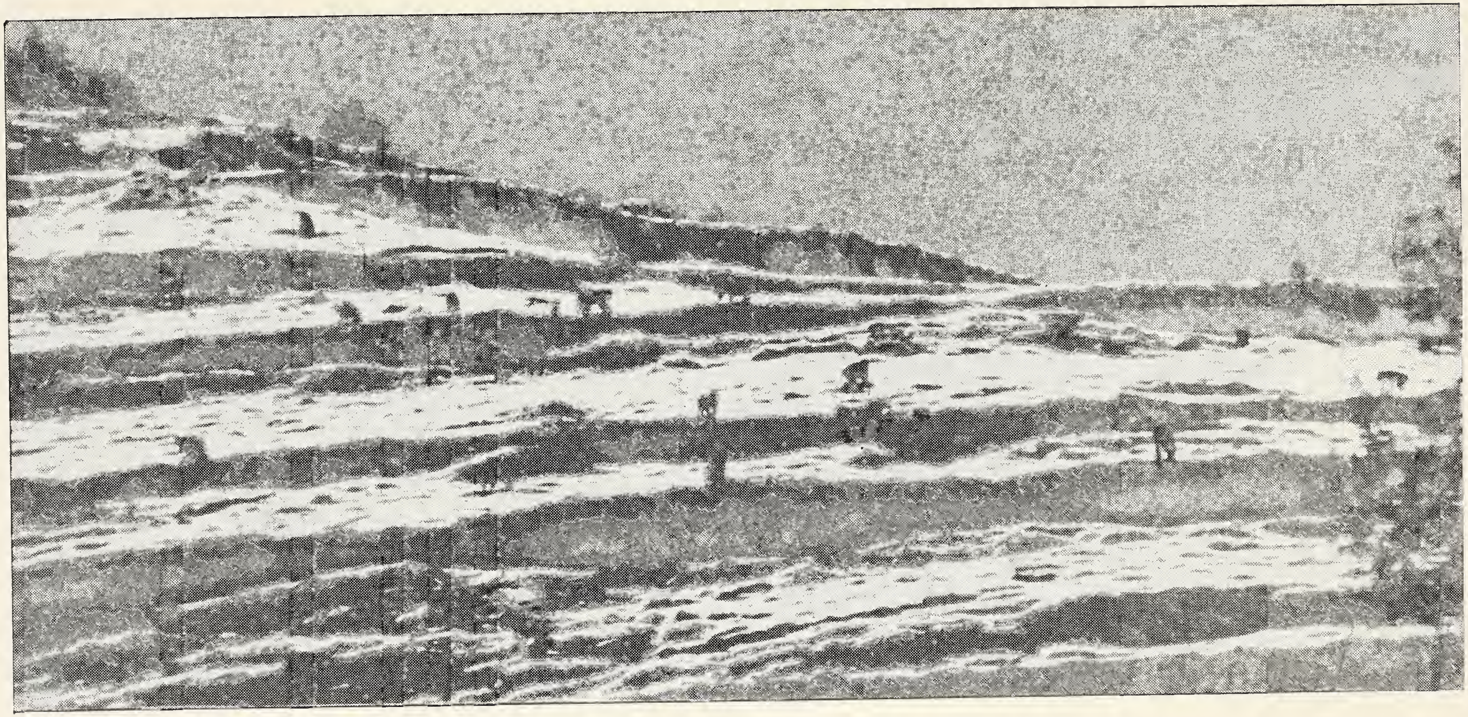
DISCUSSION

Determining factors of the upper limit of the Monkey distribution

As mentioned above, Rhesus monkeys include terrace fields in their home ranges as an essential part. The upper border of terrace fields and upper limit of the monkeys coincide with at 2,600 m a.s.l., so it could be suggested that the upper limit of the monkeys are closely related with the existence of terrace fields.

The type of forest and Monkey distribution

Rhesus monkeys in Simla, Kufri and Sungri inhabit *Pinus*-dominated forests developed on southern slopes and terrace fields. *Cedrus deodara*-dominated forests usually spread on northern slopes. The northern slope of Narkanda, above Nheri village consists of *Cedrus deodara*-dominated forest where troops frequently utilized thick growth of *Vitis himala-*



Rhesus monkey feeding in terrace fields.
(*Photo*: K. Wada)

TABLE 12

ECOLOGICAL CHARACTERS OF RHESUS MONKEYS AND JAPANESE MONKEYS IN SNOWY AREAS

	Rhesus monkeys	Japanese monkeys
Habitat	Fields and pine forests	Deciduous and evergreen broad-leaved forests
Winter movement	Lowering of utilization areas below the limit of snowfall	Reduction of home ranges compared to summer: some lowering of ranges, but living in snowy areas
Winter food list	Nuts of *Pinus* spp., grasses, potatoes, young leaves of wheat	Buds and bark of deciduous broad-leaved trees
Snow conditions	Continental climate; sometimes ground surface exposed on southern slopes below 4,000 m a.s.l.	Covering ground throughout winter; air temperature minimum, — 20°C (colder than at 4,000 m a.s.l. in the Himalayas)

yana as staple food. Huge forests, especially of *Cedrus deodara,* remain on the northern slopes along the ridge through Simla to Sungri via Narkanda, while the southern slopes are less forested. Rhesus monkeys were never found in these forests, and *Cedrus deodara* forests bordering terrace fields were little utilized (i.e., the *Cedrus deodara*-dominated forests between Sungri and Rampur, and on the northern slopes in Kufri and Narkanda). *Cedrus deodara*-dominated forests are not suitable as monkey habitats, because seeds of *C. deodara* are little utilized as food, and there is only limited food even in the undergrowth. In autumn, these forests did not supply feeding materials except for *Vitis himalayana.* Therefore, the preferred habitats for monkeys were locations with intermixed *Pinus*-dominated forests and terrace fields on southern-facing slopes under cultivation. Thus, monkey troops were more continuously distributed on southern slopes than on northern slopes (Figs. 3, 4 and 5).

Ecological adaptation to snowfall

The characteristics of Rhesus monkeys and Japanese monkeys in snowy areas are compared in Table 12. The differences of ecological characteristics are clearly related to the feeding environments. Snow cover in coniferous forest in winter restricts Rhesus monkeys' food to seeds within the cones on branches of *Pinus wallichiana.* When snowfall during the end of November and mid-December melts within a few days, forest undergrowth is exposed, and the troops do not change their areas of utilization. After the end of December, snow falls very often, and the troops change their areas of utilization as acquisition of foods becomes difficult. So changes in the area of utilization should not be affected by the lowering of ambient temperature, but rather, by the snow cover.

On snow-covered coniferous forests there are fruits of *Aesculus indica* (deciduous broad-leaved) and of *Quercus incana* or *semecarpifolia* (evergreen broad-leaved), but monkeys tend to eat mainly from *Pinus.*

Japanese monkeys inhabiting snowy forests through winter do not lower their areas of utilization to areas free from snow cover. They winter on buds and bark of deciduous broad-leaved trees in conjunction with their subcutaneous fat accumulated in autumn (Wada 1964). Although conifers distributed sporadically in deciduous broad-leaved forests supply roosting sites for Japanese monkeys, they do not offer food resources for the monkeys. There is a severe food deficiency in coniferous forests, so the distributional expansion of Japanese monkeys into coniferous forests is prevented (Wada & Ichiki 1980).

As discussed above, Rhesus monkeys are able to spread into secondary coniferous forests formed from mixed broad-leaved forests for the following reasons: (1) There are many seeds of *Pinus wallichiana* in coniferous forests as staple food in winter; and 2) Below 3,000 m a.s.l. in winter, the snow melts within a few days, and the ground surface is exposed, making food available again. It is possible that the food supply of Rhesus monkeys in winter is more abundant than in the case of Japanese monkeys in snowy districts, so in autumn Rhesus monkeys do not need to build up reserves of fat.

Rhesus monkey movements and terrace fields

In general, monkeys included in the genus *Macaca* appear in cultivated fields to feed on crops. Japanese monkeys displaced by extensive destruction of huge forest areas approach hills around fields, and then cause damage to many kinds of crops. As farmers in Japan practice intensive cultivation, there is always a conflict of interests. Therefore it is difficult to be sure that Japanese monkeys include fields in their home ranges.

In China too, Rhesus monkeys, Red-faced monkeys and Pigtailed monkeys are violently ejected from fields (Shaw 1962). In India, especially in the lower Himalayas, Rhesus monkeys certainly include terrace fields in their home ranges. The monkeys find potato remnants, grasses belonging to the Gramineae, corn, peas and young leaves of wheat as food in the fields. Indian farmers do not rigorously exclude monkeys from fields because cultivation is less intensive, and the monkeys are regarded as servants of Hindu gods. When monkeys pick up potato remnants, the farmers are indulgent. More valuable crops are protected rigorously with fire crackers. The Rhesus monkeys' menu includes nuts, seeds, fruits, young leaves and stems of plants, so cultivated crops in fields become a part of natural habit of fruit and seed feeding. On the other hand, the staple foods of Himalayan langurs are fruits and leaves of trees (Sugiyama 1976), crops in fields are eaten as substaple foods. So the langurs appear less in fields than Rhesus monkeys. In view of the different utilization of fields between the two monkeys, it would be interesting to compare their adaptability to environmental changes.

Sociological function of groupings in troop procession

As seen above, the grouping of adult females with babies to 3-yr-olds most frequently appeared during troop processions. It suggests that this is very important grouping in the troop structure.

As I described about the Doza troop, a fully adult male faced against a dog on the ground. If there is a dog near a troop, the monkeys move from branch to branch. As they usually move on the ground, troop movement from branch to branch is abnormal. The role of the adult males in such cases is to defend the monkey troop from the interference of the dog by facing it directly. Thus the adult males predominate in the rear of a troop procession and act as defenders.

Troop size, home range and forest type

In 5 troops, Neville (1968) counted an average of 17.2 individuals per troop living in chir pine forest, and Southwick, Beg and Siddiqi (1961a) counted a troop of 68 in the vicinity of Bhowali in the same habitat in India. Puget (1971) described 7 troops of sized ranging from *c.* 90 to *c.* 150 in dry forest in Afghanistan. The size of troops clearly varied in different areas. So it is difficult to indicate the relation between the forest types and troop sizes.

The sizes of home ranges in the tropical and subtropical forests varied from 1.04 to 3.11 km^2 (Neville 1968), and from 1.3 to 13.4 km^2 (Makwana 1978). These sizes per individual in the former are from 0.05 to 0.21 km^2, and in the latter from 0.15 to 0.22 km^2, so they are consistent with each other.

Comparing with my data (Table 10), the sizes of home ranges per individual in the temperate forest are smaller than in the tropical and subtropical forests. But, as the utilization rate of forest and field included in a home range is not mentioned by Neville and Makwana, it is difficult to draw a conclusion to these relations.

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SUMMARY

This observations were done in the temperate forest of Kumaon Himalaya.

1) The upper limit of Rhesus monkeys coincided with the upper border of terrace fields at 2,600 m a.s.l.

2) Home ranges of Rhesus monkeys in the survey areas include both types of habitats: cultivated terrace and forests which consist of evergreen broad-leaved-dominated and *Pinus*-dominated. The times spent in both areas were 78% in forests and 22% in fields.

3) Terrace fields are essential for the feeding place of Rhesus monkeys who take many kinds of crops.

4) Rhesus monkeys take many kinds of fruits, nuts and leaves of trees and grasses. In winter, when variety of food decreases, the monkeys take seeds of *Pinus wallichiana* as staple food.

5) The size of forest and field-occupying 7 troops averaged 37.4 individuals, and were bigger than those of troops in the Simla streets.

The size of the home range ranged from 0.6 to 2.6 km^2 by 4 troops.

6) With the snowfall, the monkeys lower their own utilizing areas in the home ranges.

7) Joining and dividing of monkey troops occurred to the relation with lowering part of home range free from snowfall. In the joining of troops, there was little antagonistic behaviour.

8) Although I distinguished 8 grouping categories in troop procession, the grouping of adult females with babies to 3-yr-olds most frequently appeared. This would be a sociologically basic grouping of Rhesus monkey troops. Adult males act as defenders.

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THE INDIAN MUGGER, *CROCODYLUS PALUSTRIS* LESSON (REPTILIA, CROCODILIA): OBSERVATIONS ON THE BEHAVIOUR OF A FEMALE FROM NATURE[1]

Lala A. K. Singh[2]

(*With six plates and a text-figure*)

A female Mugger of River Mahanadi entered captivity at Tikerpada on January 31, 1979 to mate with captive males. On August 4, 1980 she broke through the wire-mesh wall of the enclosure facing the river and returned back to the river. During captivity her behaviour developed to be like other captive muggers with respect to accepting food and relationship with keepers. Feeding was below normal to that of other muggers. Scaleless fishes were preferred. Since she did not lay any eggs during two breeding seasons she spent in captivity it is suspected that she had developed temporary sterility in the prolonged absence of a male in nature. A series of courtship behaviour, twice 'initiated' by presence of a tresspassing recessive male, were observed outside and in the water. Males were sexually active throughout the year but the female appeared receptive only during the winter. Orientation towards river was very strong during flood in the river flowing 50 m away; and this behaviour is believed to have caused the final return from captivity to nature.

INTRODUCTION

Earlier (Singh 1979) I reported that during December, 1977 to mid-February, 1978, corresponding with the breeding season for the species, a wild female mugger crocodile (*Crocodylus palustris*) from the Satkoshia Gorge Sanctuary (River Mahanadi, Orissa) showed strong sexual attraction towards 2 years and 10 months old (1.3-1.8 m length) male muggers reared in captivity at the Gharial Research and Conservation Unit, Tikerpada (GRACU). She was believed to be directed by olfactory clues to chemical secretions from the males, and perhaps also by the night time activities of the males, which included noisy fights.

The present paper records subsequent observations on the mugger, namely her capture, behaviour related to social interactions, feeding, sexual activities and water orientation, and her voluntary return to the wild after eighteen months in captivity at GRACU.

PRE-CAPTURE MOVEMENT

During 1978-floods (13.72 m above summer level in the Gorge) her appearance close to the mugger enclosure was evident from her faecal pellets. It is not known if she had come close to the enclosure any other time between April 1978 and December 1978 since there were no visual indications to her presence. But she was regularly sighted in the river near GRACU during November and December, 1978 and January 1979.

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On the night of January 18, 1979 she had come near the mugger enclosure, as was evident from tracks in the following morning. The night watcher remembered that the previous night (18 Jan.) he heard splashing sounds but had not paid any particular attenton to it since such instances do occur on many nights.

On 29 Jan., 1979 she had again come near the enclosure between 23.00 and 24.00 hours, during which time there was a small shower as was evident from temperature and humidity fluctuation graphs from the 24-hour recording thermohygrograph at GRACU. She had left behind tracks of her return journey while her incoming tracks were obliterated by the rain. She had defecated on the ground near the enclosure where the large male was housed. This was probably out of excitement.

THE CAPTURE

On the night of January 31, 1979 again she came near the enclosure at about 22.30 hours. The sound of splashing was heard from the pools, as before. This time the night watcher came near the enclosure until he heard hissing sounds from the wild mugger, only 2 metres away from him in a position where her head was juxt-apposed to the head of the large male behind the wire-mesh wall.

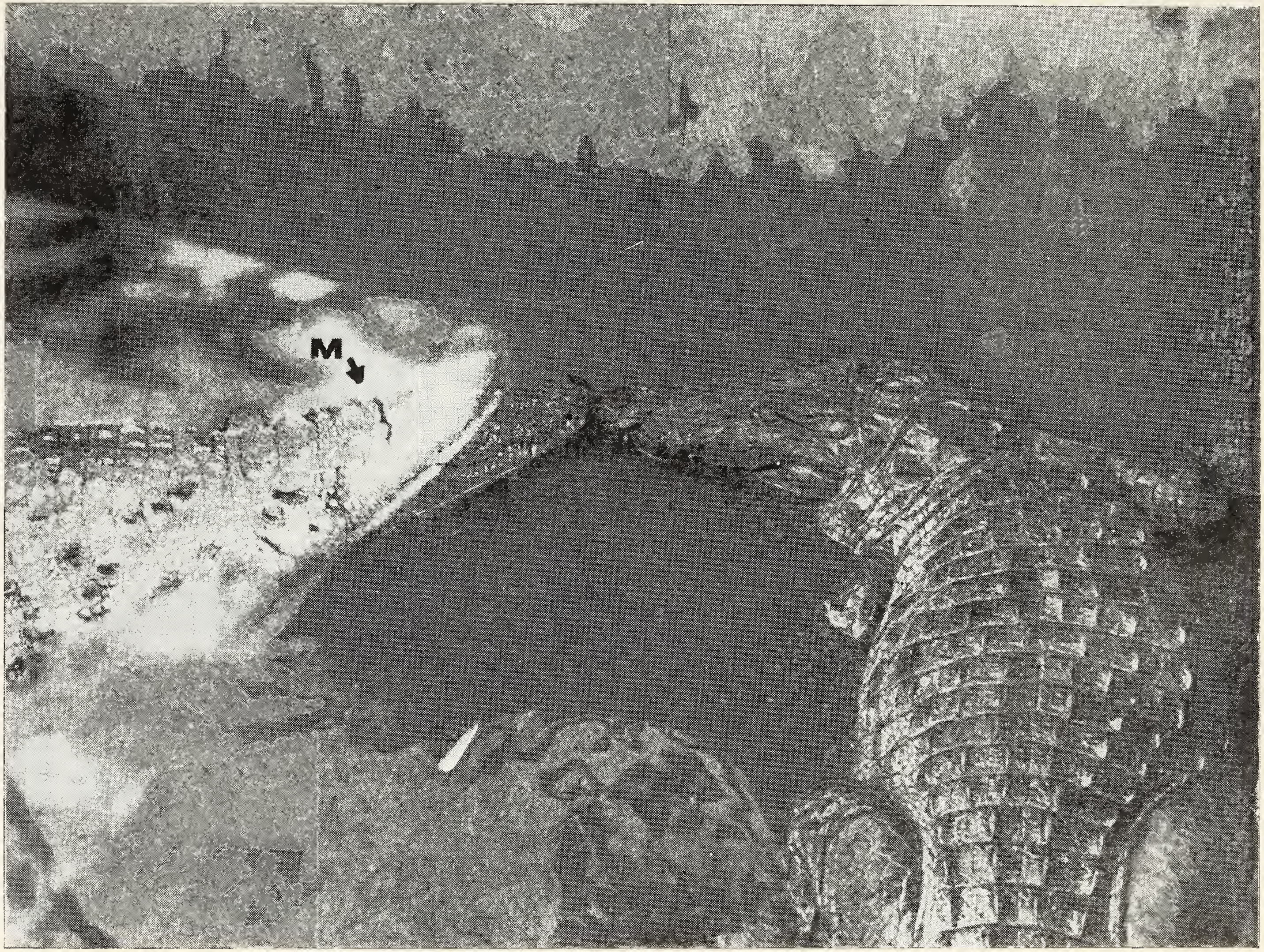
Then the entire area including the enclosure was surrounded by straw-covered bamboo-mat frames, for which arrangements were made earlier. It took about one and a half hours to assemble the staff, bring the frames and cover the area. During this time the mugger had not changed her position. A big carpet ('dari') was put over her. As usual with crocodilians, she tried to free herself from the carpet-cover by moving back, as the carpet did not completely cover the tail. When she had freed herself completely the carpet was again thrown over her and she was made to repeat her performance till she came close to the door into the enclosure. For the final time the carpet was so put that while freeing herself from the cover she moved into the enclosure. That was the eve of Basanta Panchami, a festival to worship Goddess Saraswati, the Goddess of knowledge and erudition. So the mugger was named 'Basanti'.

BEHAVIOUR IN CAPTIVITY

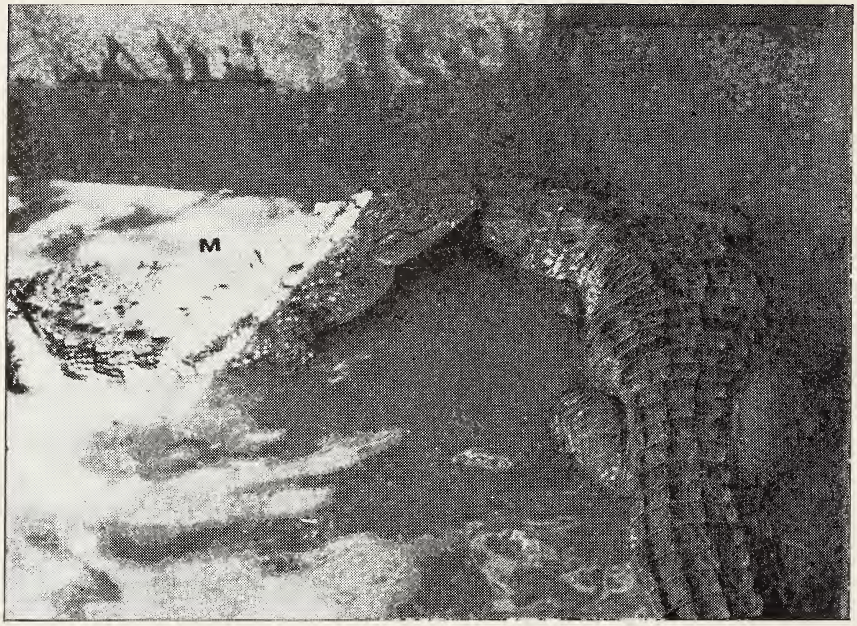
I. BEHAVIOUR TOWARDS CAPTIVE MUGGERS

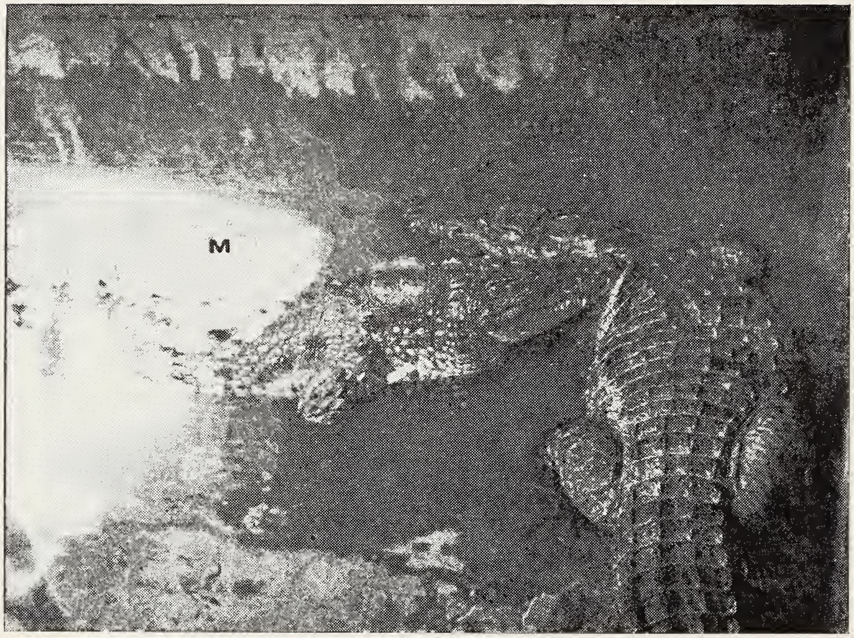
The enclosure into which Basanti entered had one large pool, LP (4 x 4 x 1 m) and two small pools, SP1 and SP2 (2 x 2 x 0.3 m) set in a total area of 52 m^2 (Fig. 1). SP2 had the large male (M1) with whom Basanti was seen 'sexually' communicating from outside before her capture. LP had the second male M2 and three females. The body lengths of Basanti, M1, M2 and the three females were 2.35, 2.16, 2.10 and 1.5-1.8 m respectively. All pools were separated from each other by a 1.5 m high wiremesh partition standing over a 45 cm high massonry wall. As expected, the behaviour of Basanti and the resident muggers of the enclosure were extremely interesting during the first several days of Basanti's capture.

Basanti had reached SP2 by climbing over the wall. On the night of capture and the following day (Feb. 1, 1979) M1 was seen many a times in a mounted posture over Basanti. During the day, when M1 basked for a couple of hours outside water, Basanti remained in water, only 30 cm deep. On the second night she climbed over the partition between SP2 and LP and reached the bigger pool, 1 m deep, having M2 and the immature females. On the mornings of the 3rd and 4th

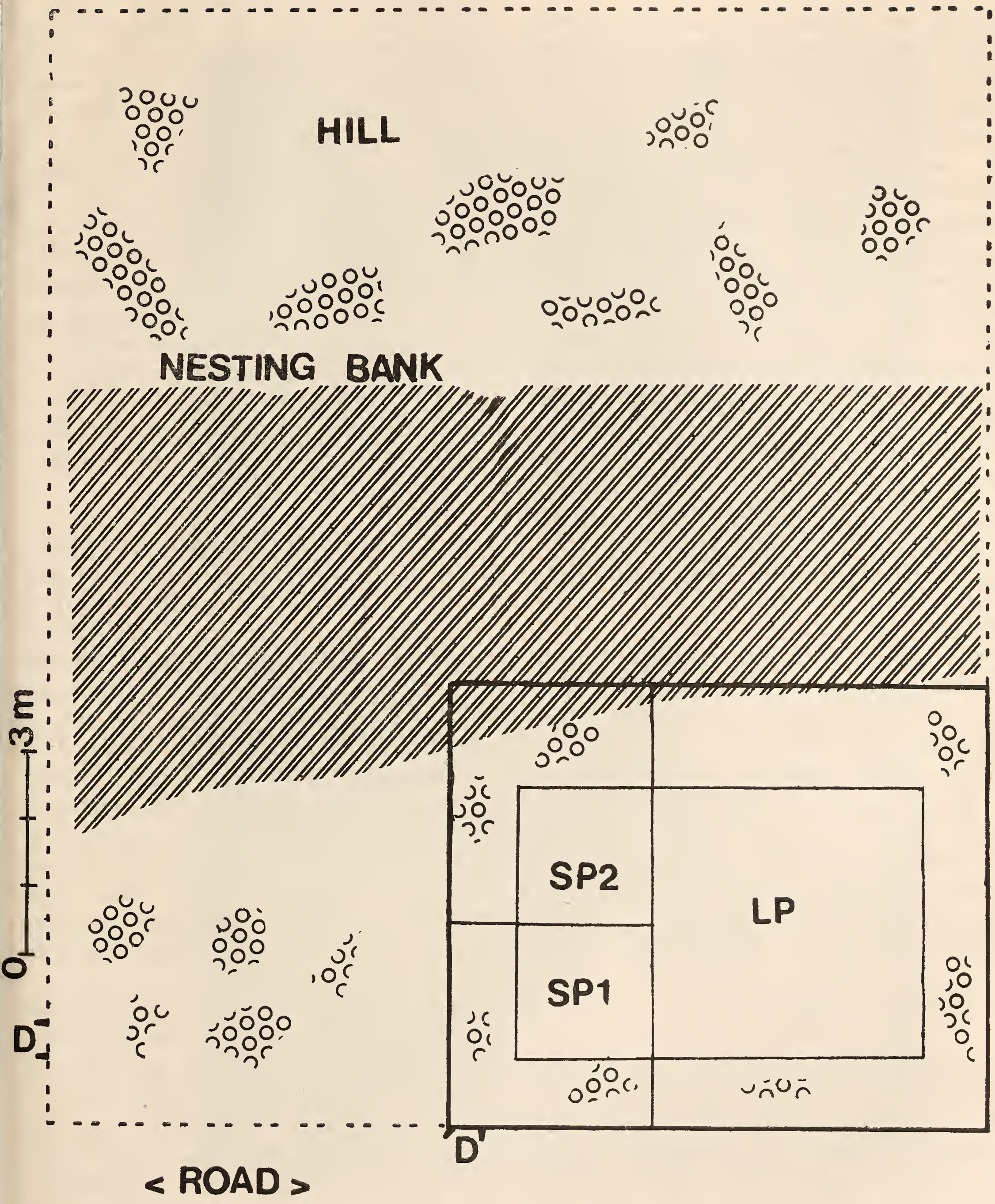


Courting behaviour when water is low. M is male. Snout to snout touch.
(*Photo*: L. A. K. Singh)





Courting behaviour when water is low. M is male.
Above: Touching the eye. *Below*: Press the back.
(*Photos*: L. A. K. Singh)


HILL
NESTING BANK
SP2
SP1
LP
D
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3m
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Fig. 1. The mugger enclosure at GRACU, Tikerpada. Area within solid lines: original enclosure into which Basanti entered through the door (D). SP1 and SP2: small pools; LP: large pool. Dotted line show the area extended (with open roof) over the original enclosure. Areas with circles show vegetations.

days M2 and Basanti were seen in mounted postures. Because of the depth of the pool only the head and nape, occasionally bobbing in water, were visible from outside.

On the 4th day morning (3 Feb.) the large pool was emptied for cleaning. When the water level came down the male appeared extremely sexually active and exhibited various courting behaviour (see below). During prolonged courting activities of M2, Basanti had produced low nasal hissings and vocal grunts—perhaps indications of mild objection. The expression in the eyes of the other females suggested that they were scared of M2. On a few occasions M2 had chased these females, and once he mounted one's back when the latter, with protruded eyes (an expression of anxiety) raised her head upward into air at an angle of about 45-60°—the crocodilian posture of submission. During this, other females remained alongside Basanti who did not show any objection.

During noon when water was filled, Basanti remained in water, M2 was basking outside and other females were also basking but along a different side of the pool.

The wiremesh partitions were removed on the 4th morning. By the afternoon of the 6th day (5 Feb.) the immature females had come out of LP and remained in SP1. Later, these females never changed their pools but M1 had on a few occasions gone to LP but was chased away soon by M2 (see below).

II. REACTION TO PEOPLE

Up to about one and a half months after capture, Basanti was extremely shy and often going under water when the entrance door was opened or even when someone approached the enclosure within 10-12 m. When she was watched she would surface briefly and then submerge.

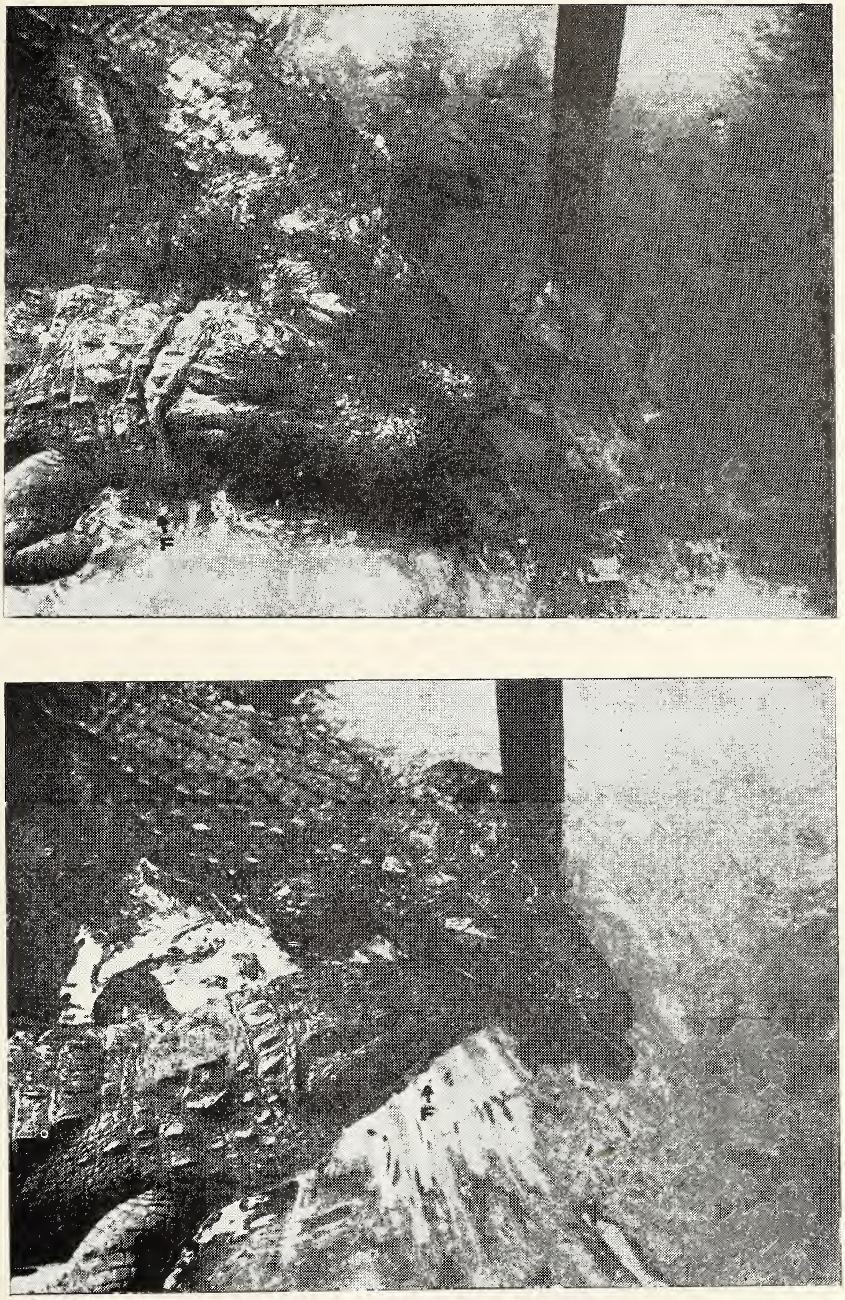
During later periods she remained on the surface even when watched. After three and a half months, when basking outside water, like other captive muggers she permitted us to approach within 45 cm from her.

Haul-out and basking: Day-time hauling out was not observed until March 10, i.e., 38 days after capture. During the period prior to this tracks suggesting night-time hauling out were noticed. This was perhaps because of the disturbance caused during the day by labourers working on the extension of the enclosure. Later, when such work stopped she basked for two to three hours every afternoon. Later when the enclosure was closed to visitors she basked during the mornings also.

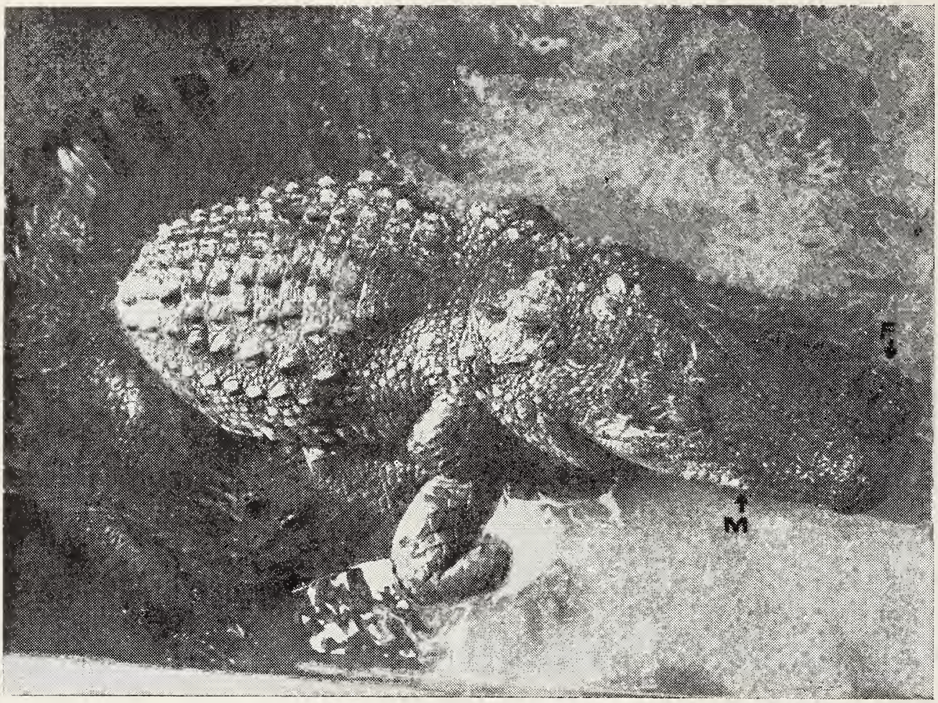
III. FEEDING

Live fish of suitable size were released into the pool for Basanti and the male in the pool was 'hand-fed' as usual. Until about the third month after capture no sign of her feeding was noticed. She appeared slimmer but her eyes indicated no sign of sickness. However, during the early part of the 3rd month at times she was seen on the surface holding dead fish between the jaws. She never swallowed these when watched. On two occasions portions of fish, which had been released alive, were seen floating on the surface. Since captive males are greedy and eat whole fishes larger than these (from which the parts were seen), it was suspected that Basanti had been extremely 'choosy'.

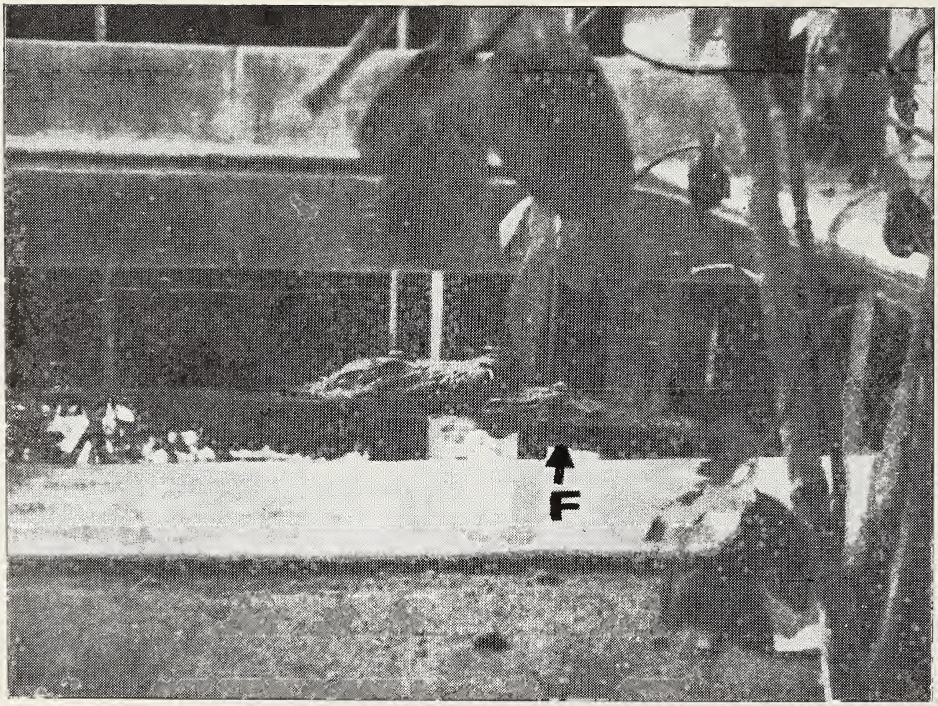
Later she responded to our approach with her feed, and even accepted the feed when thrown close to her mouth, but did not swallow the food on such occasions until she had been six months in captivity. Assuming that the male (M1) in the pool with Basanti was eating its normal quantity of food, Basanti's feeding rate was determined from the quantity of food provided in the pool and/or



Courting behaviour when water is low. F is female (Basanti).
Above: Side to side touch of the head.
Below: Male keeping the everted neck glands over the nostril of the female.
(*Photos*: L. A. K. Singh)



Mounting as an attempt to mate. (But prevented because of low water).
M — male; F — female.



Courting behaviour in water. F — female. Early postures during mounting.
(*Photos*: L. A. K. Singh)

direct observation on her feeding. Table 1 shows the feeding rates for M1, M2, Basanti and other three females. As will be seen, Basanti had eaten less than 50% of what the males ate and round 67% of what the females ate over a period of 11 months.

Basanti was more interested in food only when she was fed once a week, even during the summer. Whereas, other captive muggers were fed every alternate day during the summer, every third day during rains and autumn, and every fifth day during winter—a schedule observed according to the variation in their appetite.

IV. INTERACTIONS WITH MALE

A series of action were noticed to be executed by the male in response to Basanti. These patterns of behaviour may be considered as the various aspects of courting and these included social contacts like, (i) touching and poking the eyes, the region of the ear slit, sides of the jaws and the nape of the female with the tip of the snout; (ii) keeping the neck with everted scent (musk) glands over the nasal apertures of the female, and (iii) clasping the female behind her forelimbs. These behaviour were observed when the pool was emptied on more than one occasion.

When in water, courting behaviour were observed on many occasions during early mornings and late afternoons. A generalised sequence of courting observed and photographed for Basanti and M2 is as follows.

(i) Male approaches female.
(ii) Female stays where she is or moves to face the male.
(iii) Male floats alongside the female.
(iv) Male moves over to the back of the female. Bodies under water only heads visible.
(v) Head of the male rests over the back or nape of the female.
(vi) Male clasps the female from behind.
(vii) Bobbing heads visible intermittently. During this the head of the female points upwards at an angle of about 60° to water surface. Both male and female make nasal hissing sounds, and may exhale air through mouth producing bubbling sound in water mixed with low grunts by female. Small amounts of air may be exhaled under water through the nostril which appear on the surface in the form of a series of bubbles.
(viii) Both surface in mounting posture. Heads visible.
(ix) Male slightly opens and closes mouth four to five times. Perhaps drinking water.
(x) Male separates; surfaces at a distance.

For the accomplishment of phases from (i) to (x) it takes from 40 to 50 minutes.

(xi) After 5 to 8 minutes male moves along the periphery of the pool; comes close to female; moves away for peripheral movement again.
(xii) After 3 to 4 such peripheral movements, during which he may or may not have been joined by the female, male stops alongside the female; shifts body from the side to the back of the female. Female goes under water, followed by male. Both reappear in mounted posture.
(xiii) Repetition of (vii) to (ix) and may or may not of (xi) and (xii). The latter two phases have been seen to be repeated to a maximum of two times, each lasting from 40 to 70 minutes. Later they maintain a distance of over a metre.

Since the above behaviour were watched from a distance of only two metres away from the pool, outside the enclosure, the eyes of both were clearly visible during the entire period. The eyes appeared normal for the female but at the end of each (x)-phase the eyes of the male were definitely appearing small with drooping eyelids—perhaps a sign of exhaustion.

It was not observed on any occasion if actual intromission had occurred since the bodies were below water. The behaviour however, suggested that since the female, when receptive, raises her tail above the water surface, provision of shallow water areas in addition to deep water is beneficial for the mating pair—the female gets her fore limbs supported on the ground.

Clicking effect: On only two occasions courting was 'clicked' because of tresspassing by M1, who had approached close to Basanti basking outside water. Both the times M2 fiercely chased away M1 and immediately thereafter exhibited social contacts as described above. When Basanti entered water the phases from (i) onwards were displayed.

Season: Courting activities initiated by the male were observed throughout the year, but the female appeared to be highly responsive only during the morning and afternoon hours in winter.

During the first year Basanti appeared to be less tolerant to M2 after the mating season in March. During the night M2 remained out of water or in a different pool, returning back the following morning when we go to the enclosure for our usual work. While returning, he was received with mildly 'objecting' grunts from Basanti. Because of this M2 was transferred from the enclosure and M1 was allowed into Basanti's pool, but he was also rejected and therefore, was taken out of the enclosure. During October M2 was brought back to the enclosure. After a few objections, M2 was accepted by Basanti and the courting behaviour continued during the winter.

V. WATER ORIENTATION BEHAVIOUR

During the initial phases of Basanti's captive life, checks during the night had revealed about Basanti's movement along the walls of the enclosure. This was then regarded as 'exploratory'. But during the monsoon, when all males were out of the enclosure and the river was in high flood, only fifty metres away from the enclosure, she showed strong orientation towards the river. During post monsoon (Autumn) such behaviour was either absent or not very suggestive of the urge to go into the river.

BACK TO THE WILD

Although Basanti had spent two breeding seasons (1979 and 1980) at GRACU, she did not lay any eggs. During 1980 a small pit, 20 cm deep and 10 cm diameter was dug during March, but it was not confirmed to be an act by Basanti because three other females were in the same enclosure.

On the morning of August 5, 1980, an opening was noticed between the joining line of two wiremesh sheets on the wall facing the river, and Basanti was missing from the enclosure. On the same day she was observed in the river about 2 km downstream. The total duration of her stay in captivity was over eighteen months.

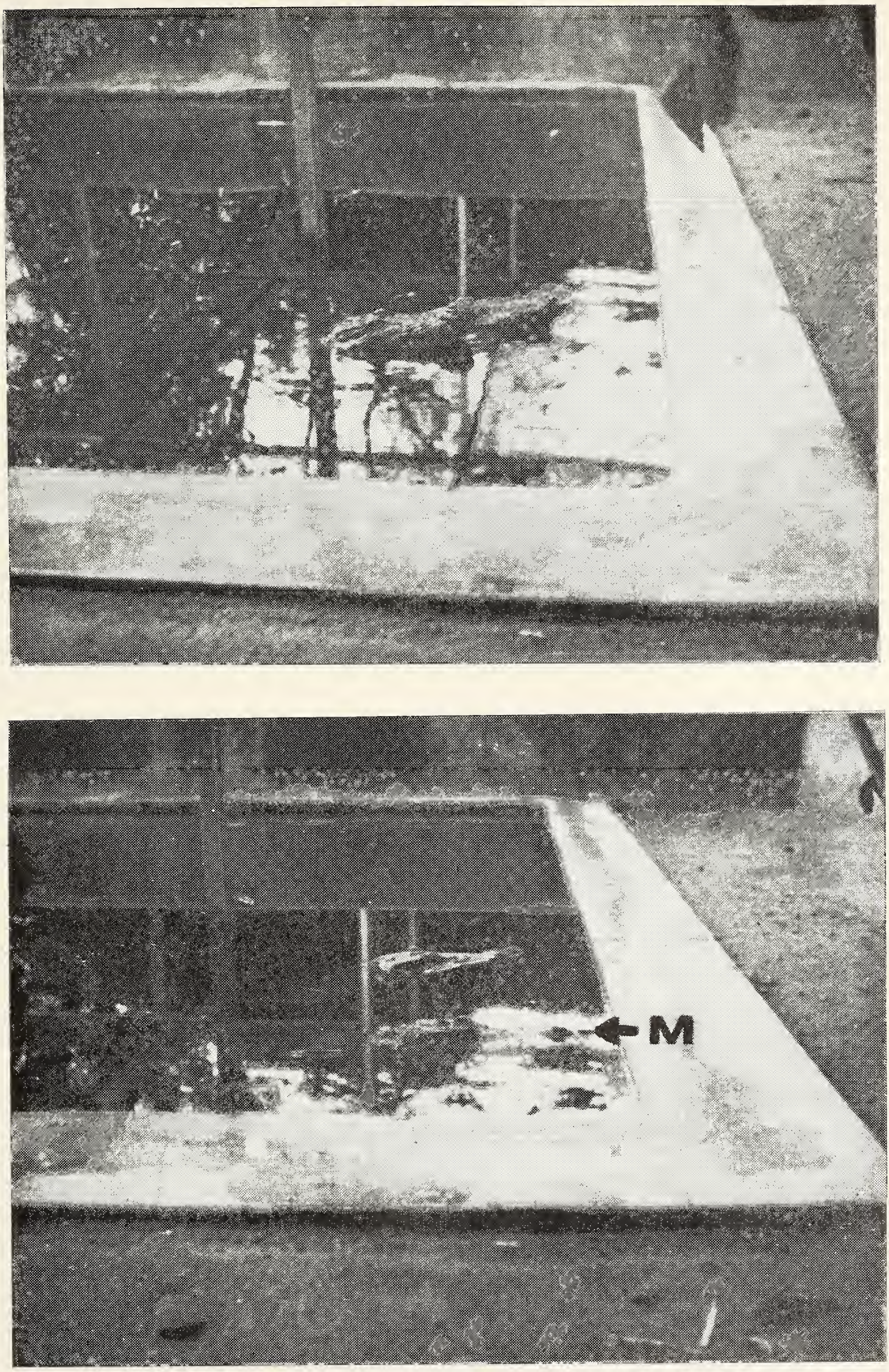
DISCUSSION

From the above although no generalisation can be made on the behavioural biology of the Mugger, the observations do add to the scant existing knowledge.

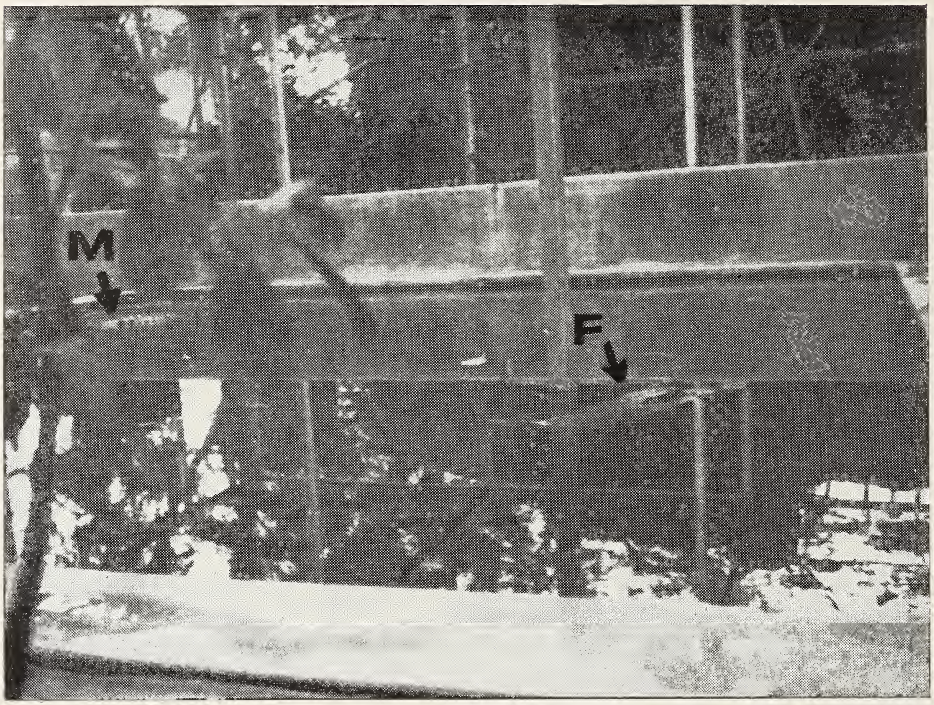
Feeding: Crocodiles caught from the wild do cease feeding for some time when kept in captivity. This has also been observed recently for saltwater crocodile hatchlings (Kar, S., pers. comm.) and a sub-adult (Choudhury, B. C., pers. comm.). In the latter instance the crocodile had not eaten anything for nearly a year. Non-feeding by Basanti during the first three months supports further the above observation.

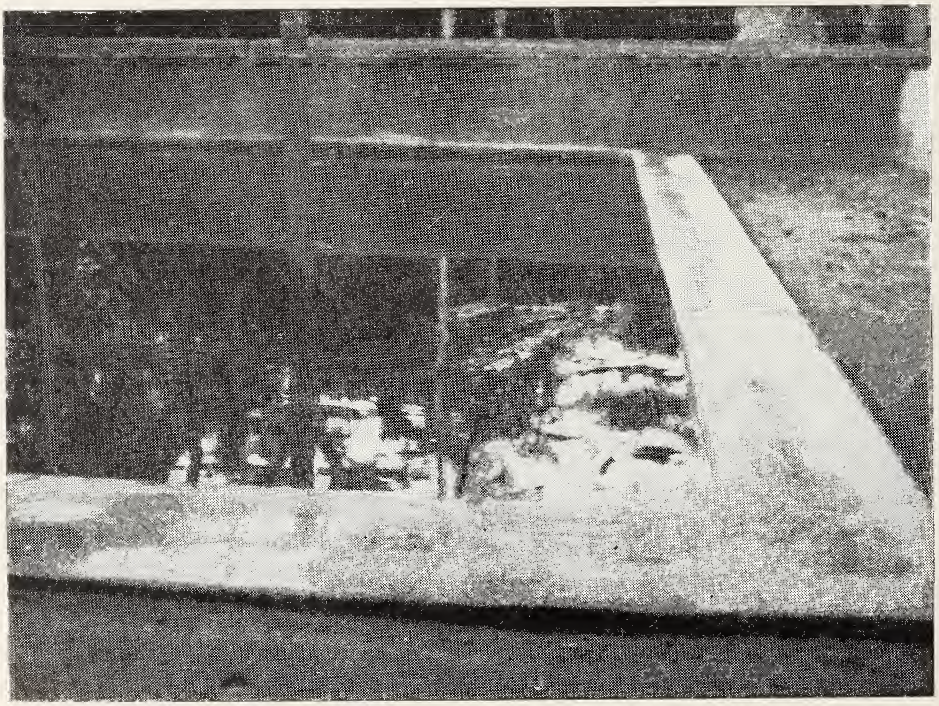
Consumption of low quantities of food may

PLATE V



Courting behaviour in water. M — male.
Above: Late postures during mounting.
Below: Separation begins after phase (x) (see text).
(*Photos*: L. A. K. Singh)





Courting behaviour in water. M — male, F — female.
Above: Peripheral movement by male when female is stationary. (Phase xi: see text).
Below: Approach by male after peripheral movement for recourting. (Phase xii: see text).
(*Photos*: L. A. K. Singh)

be a normal behaviour in nature in contrast to captive crocodilians who become greedy and are over-fed.

Changed reaction towards male: It is difficult to explain why Basanti objected to the presence of the males after the mating season. The only possible reason appears to be the frequent courting attempts made by the captive males. In captivity crocodilians and other animals appear to be sexually more active (For e.g., *see* Dagg and Foster 1976).

Courtship and mating: The courtship and mating(?) season observed in the present paper agrees to that observed by Dharmakumarsinhji (1974) (March), Whitaker and Whitaker (1976) (January-March) and Yadav (1979) (February/March), but is a little different from David (1970) (December-January).

The behaviour observed during courting is in many respects similar to that observed by Dharmakumarsinhji (1947) on wild muggers. The swimming behaviour is very similar. 'Ducking' behaviour, mounting in water and separation after matings for renunion are also similar. Yadav (1979) recorded mating to last for 30-50 minutes but noted that no sound was produced during mating. In the present observation, however, sounds like hissing and grunts were made by the female.

Failure to lay eggs: It is not known what was the exact age of Basanti. However, features like a high skull, pierced premaxilla (by the mandibular teeth) and a lustre-less skin indicated an age of over fifteen years. Since this age was not early for breeding, nor was late enough to have stopped breeding, Basanti's failure to lay even infertile eggs may have been due to her having developed a temporary sterility, perhaps in the absence of a suitable male in the Satkoshia Gorge. Acharjyo and Mishra (1981) have reported that in the absence of a male, a captive Saltwater Croco-

TABLE 1

FEEDING (FISH) RATES OF BASANTI MUGGER AND OTHER CAPTIVE MUGGERS (M1-M2: MALES; 3F: THREE IMMATURE FEMALES) AT GRACU, TIKERPADA. Quantities are in Kg.

Period	Basanti	M2	M1	3F; total (mean)	M1,M2, 3F total (mean)
June, 1979	4.4	12.0	13.9	22.2 (7.4)	48.1 12.0)
July	6.1 (incl. 1 bird: 0.5)	10.0	13.5	21.85 (7.28)	45.35 (11.3)
Aug.	8.8	15.0	20.0	36.3 (12.1)	71.3 (17.8)
Sep.	18.0	22.2	23.4	36.3 (12.1)	81.9 (20.4)
Oct. (1.10-28.10)	13.0	20.0	30.9	34.3 (11.4)	85.2 (21.3)
Nov. (29.10-1.12)	10.0	25.0	25.5	36.1 (12.0)	86.6 (21.6)
Dec. (3.12-30.12)	6.3	18.0	20.4	27.8 (9.2)	66.2 (16.5)
Jan., 1980 (31.12-3.2)	10.0	20.8	21.7	41.1 (13.7)	83.6 (20.9)
Feb. (4.2-2.3)	9.0	21.9	23.7	35.7 (11.9)	81.3 (20.3)
March (3.3-30.3)	9.0	21.55	24.0	35.7 (11.9)	81.25 (20.3)
April (31.3-4.5)	20.0	27.2	30.7	42.4 (14.1)	100.3 (25.0)
Total (June 1979-April 1980)	106.9	213.65	247.7	369.75 (123.25)	835.8 (208.9)
Mean (monthly)	9.71	19.42	22.51	33.61 (11.20)	75.9 (18.9)

dile laid eggs from 1975 each year up to 1978. I ascertained later, that she stopped laying thereafter, perhaps yet another case of development of temporary sterility in the absence of successful completion of the entire sequence of behaviour in breeding.

Water orientation and return to the wild: The behaviour of Basanti was for some time exactly like that of other captive muggers, particularly in allowing close approach during feeding. She appeared normal to captivity that she had volunteered in January 1979. However, during the monsoon she showed very strong attraction towards the river. Such water orientation behaviour is similar to that noticed for the Gharials at GRACU (Singh 1978). During the post-breeding season this pull was strong enough for her to break through the wiremesh wall and enter the river, flowing only 50 m away.

(NOTE : While preparing the present version of the paper from a draft prepared in August 1980, I was informed that through a trap I had designed, Basanti entered captivity again in February 1981, laid eggs in captivity and now she has five hatchlings.)

ACKNOWLEDGEMENTS

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AUTHORS' CATALOGUE OF THE BOTANICAL ARTICLES PUBLISHED IN THE JOURNAL OF THE BOMBAY NATURAL HISTORY SOCIETY-II (VOL. 67-76; 1970-1979)[1]

Compiled by
A. R. Das[2]

The first catalogue of this series was published in this journal [Vol. 73(1): 98-120, 1976] representing Vols. 1-66, 1886-1969. The second series is presented here covering subsequent ten years. For easy retrieval of botanical informations, scattered in this journal, such catalogues are expected to go a long way as an important aid to scholars, engaged in research of botany in India. Entries have been done here alphabetically under single author, followed by joint authors alphabetically and then chronologically. Similar catalogues are expected to be compiled in future, after sufficient number of volumes of this journal are published.

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ONTOGENY OF TEETH ROW STRUCTURE IN *RANA TIGERINA* TADPOLES[1]

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(*With twelve text-figures*)

A study on the ontogeny of labial teeth structure of Indian bull frog *Rana tigerina* was done by examining laboratory reared tadpoles. The teeth row formula was determined for every stage of development beginning with external gill stage and ending with both limb + tail stage. It is noted that the number of teeth rows on both upper and lower jaw reached a maximum of 5(2-5)/0/(1-3) at well developed hindlimb stage, but only one tadpole out of five in limb paddle with five toes was found with six rows in the lower jaw. It is interesting to note that there were variations in the rows of teeth even in the same stage of development. There was a decrease in the number of teeth rows from the beginning of the emergence of forelimb upto complete tail resorption. A comparison of the present study with that of Agarwal and Niazi (1977) has been made, and the variations in the teeth rows in different stages of development have been pointed out. The reason for this variation has also been discussed.

INTRODUCTION

The labial teeth are some of the most distinguishing features for identification of amphibian larvae. Workers like Campbell (1931), Taylor (1942), Wright and Wright (1949), Stebbins (1951 and 1954), Orton (1952), Zweifel (1955 and 1964), Bragg and Bragg (1959), Starret (1960), Altig (1970), Altig and Pace (1974), and Lee (1976) have reported on the teeth structure of the tadpoles of different species of frogs from temperate climate. Orton (1953 and 1957) has proposed a classification of frog families based upon the keratinized mouth parts. A detailed report on the internal oral features of larvae from eight anuran families of U.S.A. has been described by Wassersug (1980). In a study on ontogeny he (Wassersug 1976) has also described the internal oral features of *Hyla regilla.* Webb and Korky (1977) while studying the variation in the tadpoles of frogs of *Rana tarahumarae* group in Western Mexico have described the teeth row formula of that species and have given a formula for teeth structure.

Our knowledge on the teeth structure of Tropical species of anuran is limited. So in the present study an attempt has been made to focus on the ontogeny of teeth structure in the Indian bull frog *Rana tigerina.* Workers like Annandale (1917), McCann (1932), Kirtisinghe (1957) and Agarwal and Niazi (1977) have reported about the teeth row structure of this species, but they have not described the teeth structure in detail. Their description is based on some specific stages. In the present observation the teeth row structure of *Rana*

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tigerina has been studied in different stages of their development.

TABLE 1

LABIAL TEETH ROW FORMULA OF *Rana tigerina*

Stages	Number examined	Length of tadpole in mm. with the nos. examined within brackets.	Labial teeth row formula*
External gills	5	7.5(3),8(2)	Without teeth, but with beak.
One external gill	15	10.5(4),10(2)9.5	1/0/2(1)
		10.5,9.5,11	1/0/2
		11,10.5	1/0/2
		9,9.5	1/0/2(1)
		9	1/0/0
Operculum complete	10	11(3),11.5(3)	1/0/2(1)
		11.5(2)	1/0/2
		9,9.5	1/0/1
Feeding	5	10.5(3)	2(2) /0/2
		11(2)	2(2) /0/3(1)
Pigmented pearshaped tail	12	20(2),19.5(2),21	3(2-3) /0/3(1)
		19.5(2)	3(2-3) /0/3(1-2)
		18(2)	3(2-3) /0/2
		15(2)	2(2) /0/2
		15	4(2-4) /0/3(1)
Limb bud	10	21.5(2),21(2)	3(2-3) /0/4(1-2)
		22(2)	4(2-4) /0/4(1-2)
		25(2)	4(2-4) /0/4(1-3)
		24(2)	3(2-3) /0/4(1-3)
Limb paddle	5	29.5(3)	4(2-4) /0/4(1-2)
		30(2)	4(2-4) /0/5(1-3)
Limb paddle with 5 toes	7	31(4)	4(2-4) /0/4(1-2)
		32(2)	4(2-4) /0/5(1-4)
		37	4(2-4) /0/6(1-5)
Hind limb	5	40(3),39.5(2)	4(2-4) /0/4(1-2)
Well Dev. hind limb	5	44(2)	4(2-4) /0/5(1-3)
		46(3)	5(2-5) /0/5(1-3)
One fore-limb	5	48(2)	3(1-3) /0/4(1-3)
		46(2)	3(1-3) /0/3(1-2)
		47	3(1-3) /0/2(1)
Both limb + tail	10	46.5(2),47(2)	3(1-3) /0/2(1)
		40(2)	3(1-3) /0/3(1-3)
		33(2)	2(1-2) /0/2(1-2)
		30(2)	3(1-3) /0/2(1-2)

* According to Webb and Korky (1977).

MATERIALS AND METHODS

The tadpoles of different stages of development were obtained in the laboratory by the methods described earlier (Dutta and Mohanty-Hejmadi 1976 and Dutta 1979). They were fixed in 10% formaldehyde for observation of their teeth structure. The larval stages described by Dutta (1979) were examined by binocular microscope, and the structures were sketched. Dental formula was determined according to the methods recommended by Webb and Korky (1977). A comparative statement of the present study with the studies of Agarwal and Niazi (1977) has been made.

OBSERVATIONS

A study on the ontogeny of labial teeth structure of Indian bull frog *R. tigerina* indicates that the number of teeth rows change with the stage of the tadpole as expected. For each stage even there is individual variation as reported for other species. Therefore, the structure of labial teeth of several tadpoles for each critical stage was examined (Table 1). Agarwal and Niazi (1977) have also studied the teeth structure of some developmental stages of this species. Therefore, a comparison of the present observations with those reported by Agarwal and Niazi (1977) is also included here (Table 2).

In general, the horny beaks are visible for the first time when the external gills are well developed. The first traces of labial teeth appear at the stage when operculum is closed on one side. By the time the tadpoles reach metamorphic climax there is shedding of labial teeth.

TABLE 2

COMPARATIVE ACCOUNT OF TEETH ROW STRUCTURE OF *R. tigerina* AS OBSERVED BY AGARWAL, NIAZI AND THE PRESENT STUDY

AGARWAL AND NIAZI (1977)	PRESENT STUDY
1. *External gills*:	
White beak	Black beak
2. *Operculum fold*: *One side closed*:	
One row on upper jaw	One in upper jaw
One row on lower jaw	0 to 2 in the lower jaw
3. *Operculum fold complete*:	
One row on upper jaw	One in upper jaw
Two rows on lower jaw	One to two rows in lower jaw.
4. *Feeding stage*:	
Not observed	Two in upper jaw
	Two to three in lower jaw
5. *Pigmented tail stage*:	
Not observed	Two to four in upper jaw
	Two to three in lower jaw
6. *Limb bud*:	
Upper jaw 2(1) or	3(2-3) or 4(2-4)
3(2-3) or 4(2-4)	(None had two rows)
Lower jaw 2 or	Four rows with either
3(1) or 4(1-2)	4(1-2) or 4(1-3).
	(Only 6 out of ten had the structure 4(1-2) observed by Agarwal and Niazi)
7. *Limb paddle*:	
Upper jaw 4(2-4)	Upper jaw 4(2-4)
Lower jaw 4(1-2)	Lower jaw 4(1-2) or 5(1-3)
8. *Limb paddle with 5 toes*:	
Upper jaw 5(2-5)	Upper jaw 4(2-4)
Lower jaw 5(1-3)	Lower jaw 4(1-2) or 5(1-4) or 6(1-5)
(Last two rows uninterrupted)	(Only the last row uninterrupted)
9. *With both limbs*:	
Same as for previous stage	Number of teeth rows reduced due to shedding.

External gill stage:

At external gill stage, the mouth of the tadpoles consisted of a pair of black horny beaks, consisting of an upper mandible with a median cusp and a lower mandible with a corresponding notch for the cusp. There were no horny teeth (Table 1, Fig. 1). By the time gills on one side were covered by the operculum horny teeth appeared and the teeth row formula varied from tadpole to tadpole (Fig. 2A-E). The teeth row formula ranged from 1/0/2 to 1/0/0 in the 15 tadpoles examined. In some of the tadpoles the teeth rows were weakly developed (Fig. 2B, 2D, and 2E).

Operculum complete stage:

A total of ten tadpoles were examined for this stage. Among these two had a teeth for-

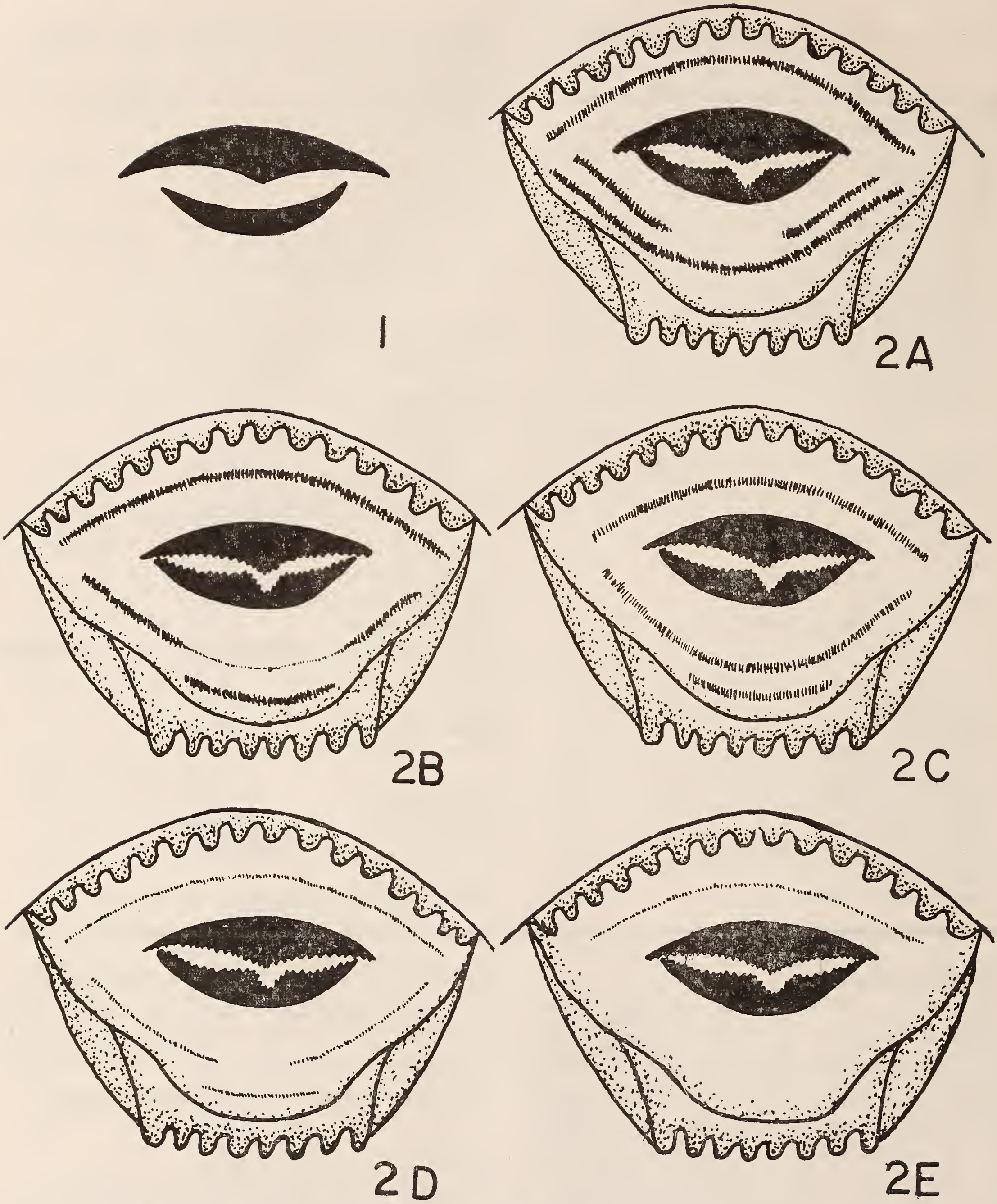
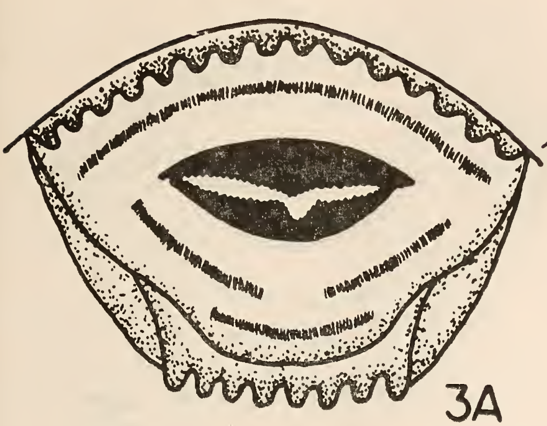
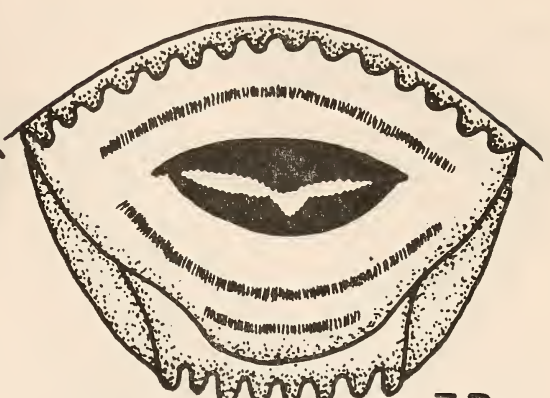

1
2A
2B
2C
2D
2E

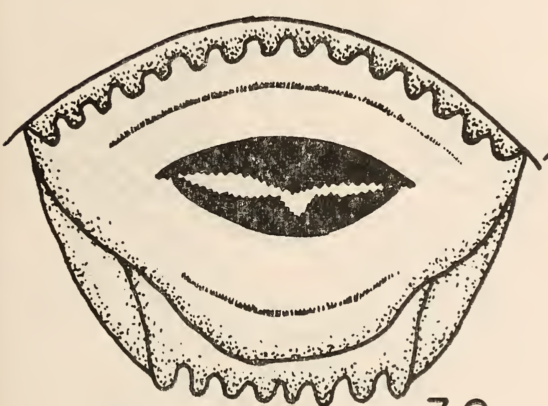
Fig. 1. External gill stage. Fig. 2A-E. One external gill covered stage.



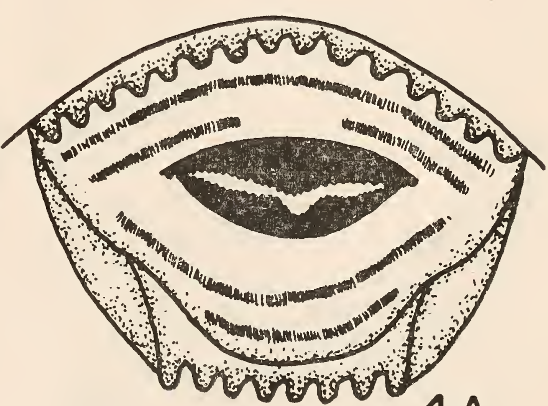
3A



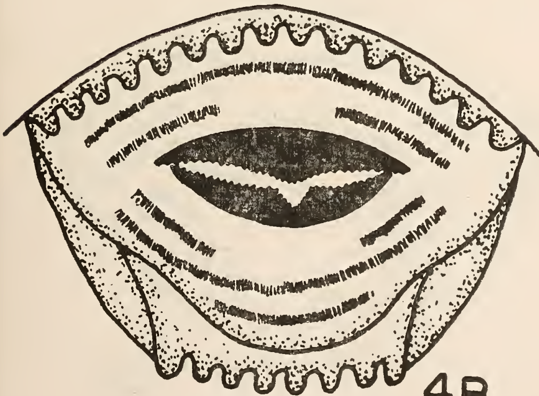
3B



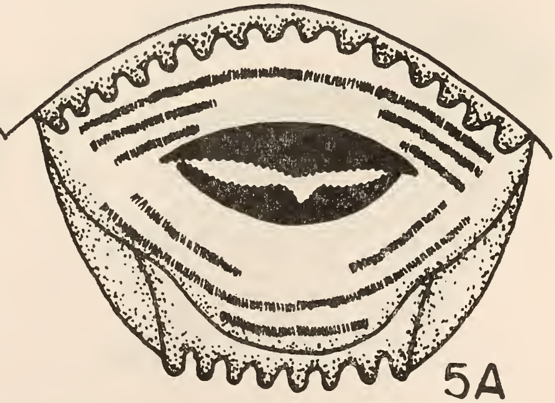
3C



4A

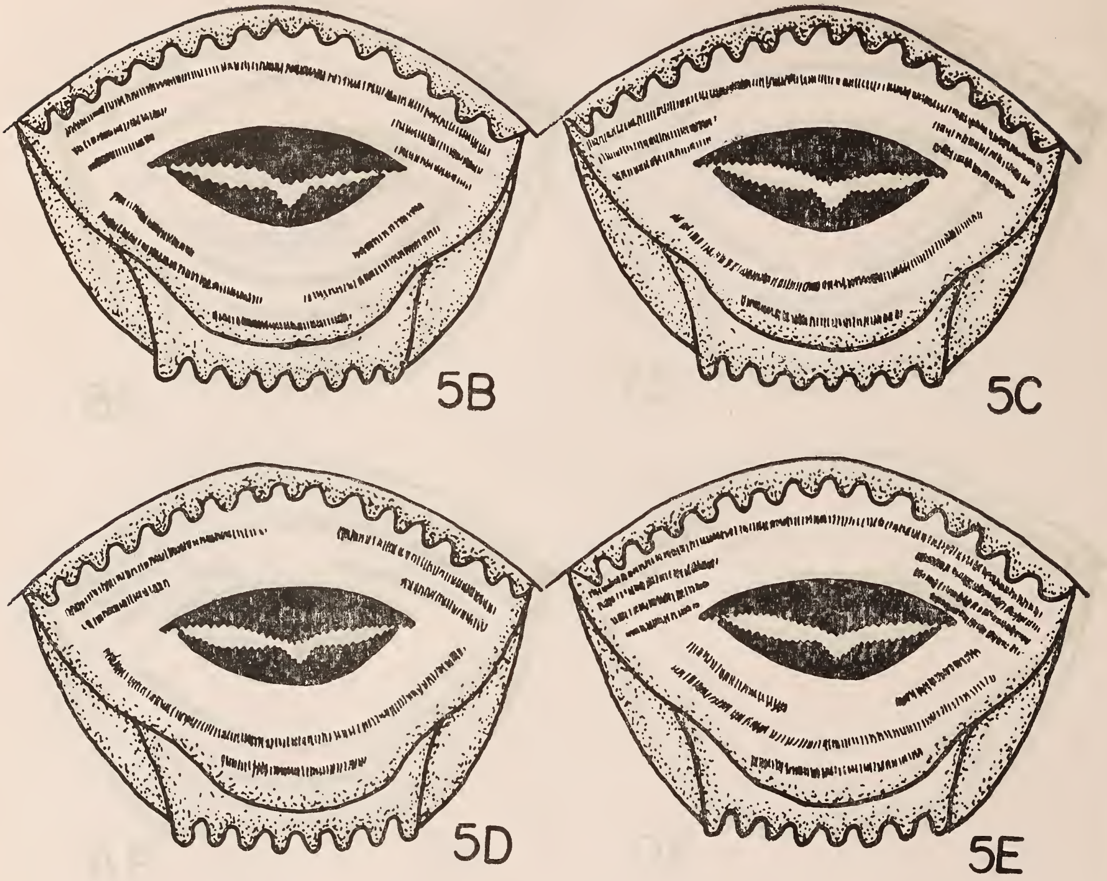


4B



5A

Fig. 3A-C. Operculum fold complete. Fig. 4A and 4B. Feeding stage.
Fig. 5-A. Pigmented pear shaped tail.



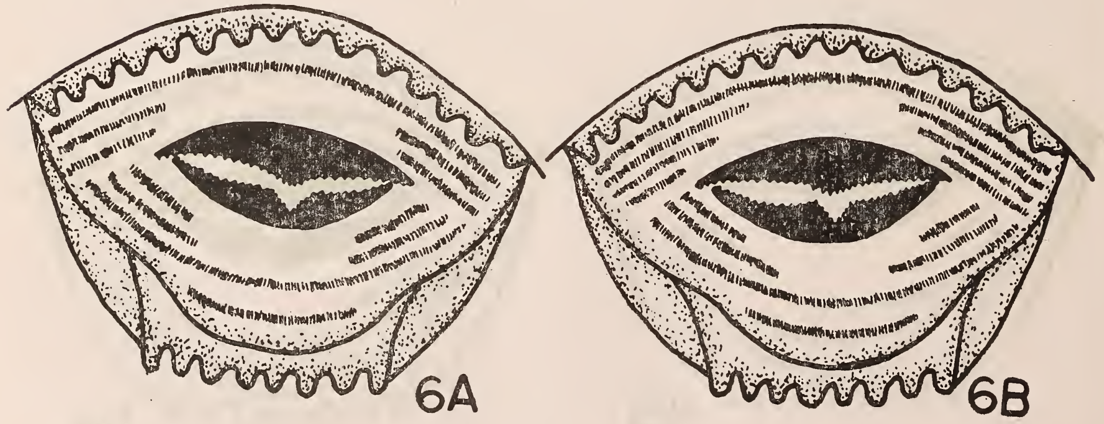


Fig. 5-B-E. Pigmented pear shaped tail. Fig. 6A-B. Limb bud stage.

mula of 1/0/1 (Fig. 3C), six had 1/0/2(1) (Fig. 3A) and two had 1/0/2 (Fig. 3B). From this it is evident that the teeth row in the upper jaw was constant but the rows on the lower jaw varied. In some cases teeth in the two jaws were weakly developed (Fig. 3C) like the previous stage. This was perhaps due to the smaller size of this particular tadpole.

Feeding stage:

At this stage a total of five tadpoles were examined. From them three were with a teeth row formula of 2(2)/0/2 and two with 2(2)/0/3(1). The teeth row on the upper jaw were constant, with the first one uninterrupted. In three tadpoles the two rows in the lower jaw were uninterrupted (Fig. 4A), but in other two tadpoles the first row in the lower jaw was interrupted and the second and the third rows were uninterrupted (Fig. 4B).

Pigmented tail stage:

The teeth row formula varied from 2(2)/0/2 to 4(2-4)/0/3(1) (Fig. 5A-E) in the twelve tadpoles examined. The number of teeth rows in the upper, jaw varied from 2 to 4 out of which the first one was uninterrupted. Similarly the number of teeth rows varied from 2 to 3 in the lower jaw out of which the last row was uninterrupted.

Limb bud stage:

Out of ten tadpoles examined, four had a teeth row formula of 3 (2-3)/0/4(1-2) two with 4(2-4)/0/4(1-2), two with 4(2-4)/0/4 (1-3) and two with 3(2-3)/0/4(1-3). This showed that the rows on the lower jaw were constant and the fourth row was uninterrupted in all the tadpoles but the teeth row on the upper jaw varied from 3 to 4 with the first one uninterrupted (Fig. 6A-D).

Limb paddle stage:

In this stage, three out of five examined had a teeth row formula of 4(2-4)/0/4(1-2) and other two with 4(2-4)/0/5(1-3). This showed that the teeth rows on the upper jaw of all the tadpoles were constant with the first one uninterrupted, while the rows in lower jaw varied from 4 to 5 with the last two rows uninterrupted (Fig. 7A and 7B).

Limb paddle with 5 toes:

At this stage of development four tadpoles had a teeth row formula of 4(2-4)/0/4(1-2), 2 with 4(2-4)/0/5(1-4) and one with 4(2-4/0/6(1-5). So the rows of teeth on the upper jaw were constant with the first one uninterrupted but the number of rows on the lower jaw varied from 4 to 6 (Fig. 8A-C).

Hind limb stage:

Though this stage continued from initiation of limb paddle with five toes upto well developed hind limb stage yet the teeth structure was constant, that is 4(2-4)/0/4(1-2) in all the five tadpoles examined (Fig. 9). The first row on the upper jaw and the third and fourth row on the lower jaw were uninterrupted ones.

Well developed hind limb stage:

The number of labial teeth rows reached a maximum at this stage. Out of five tadpoles examined two had a teeth row formula of 4(2-4)/0/5(1-3) and other three with 5(2-5)/0/5(1-3), so the rows on the upper jaw varied with the first one uninterrupted while the rows in the lower jaw were constant (5) with the fourth and the fifth one uninterrupted (Fig. 10A and 10B).

One fore limb stage:

In all the five tadpoles examined the upper jaw had three interrupted rows of teeth, per-

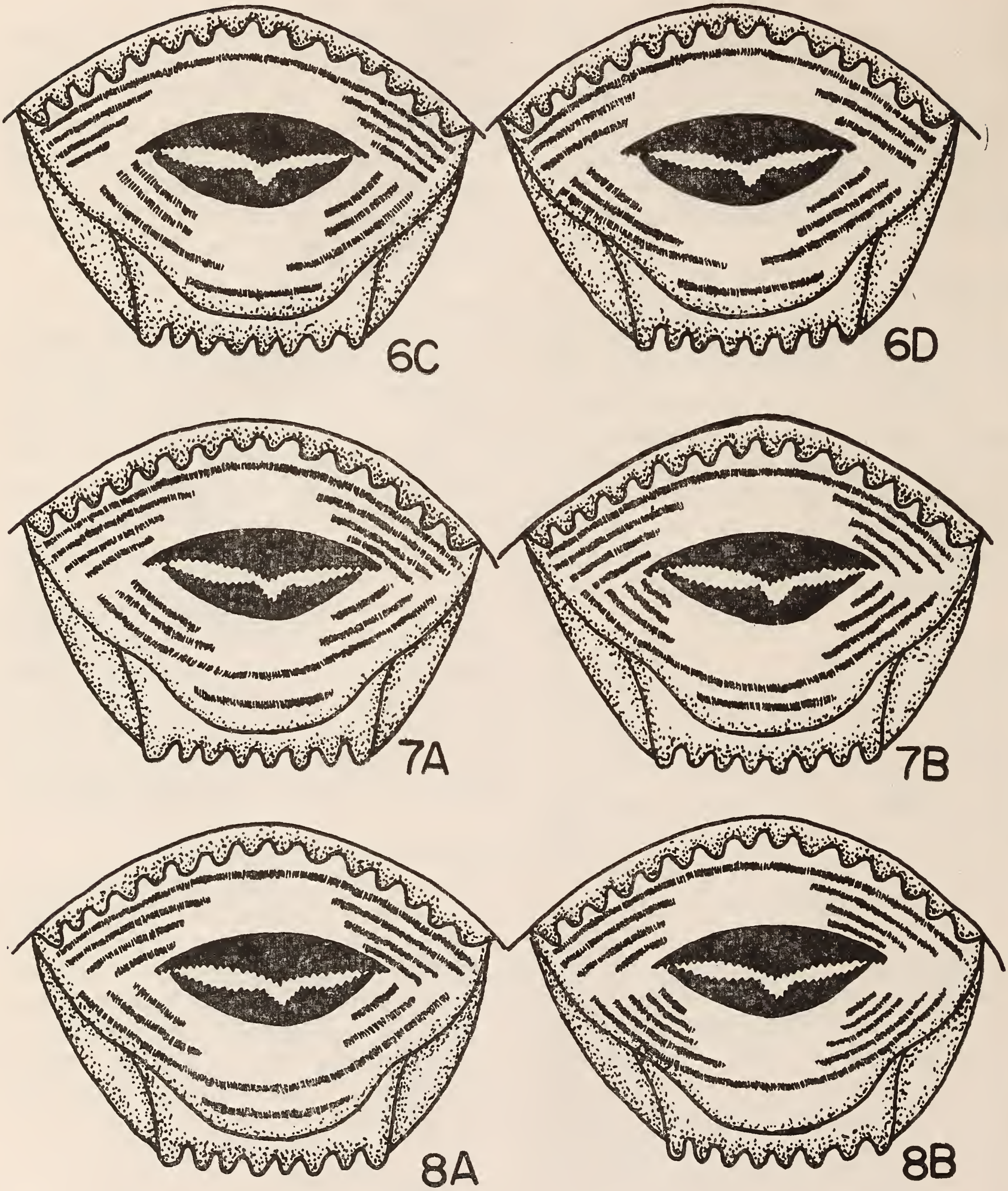
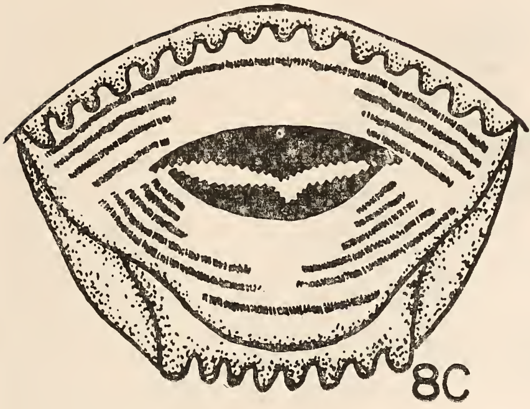
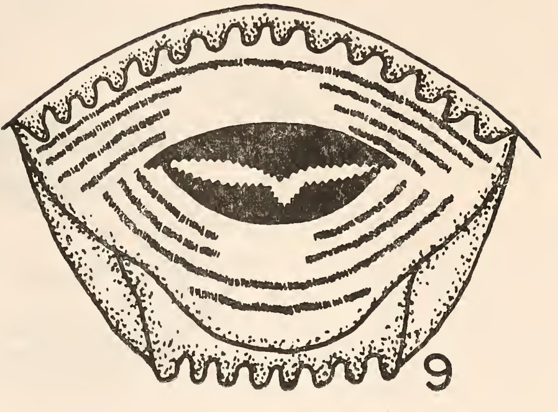


Fig. 6C-D. Limb bud stage. Fig. 7A and 7B. Limb paddle stage. Fig. 8A-B. Limb paddle with five toes.


8C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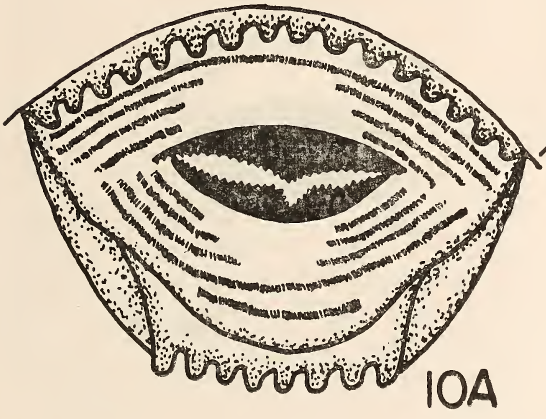
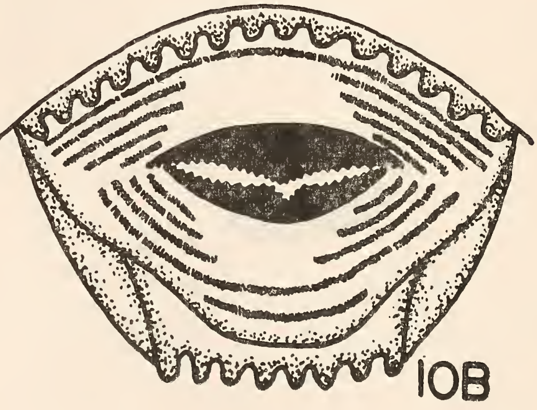
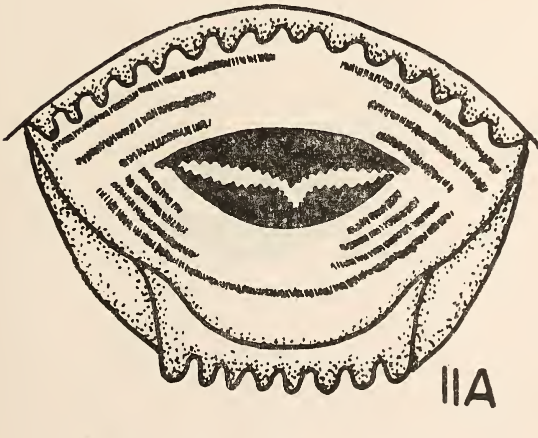

10A


10B


11A

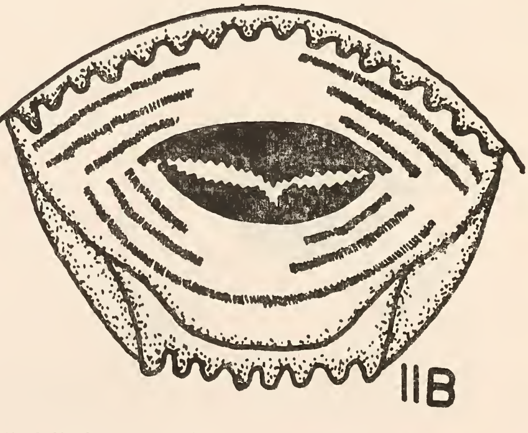
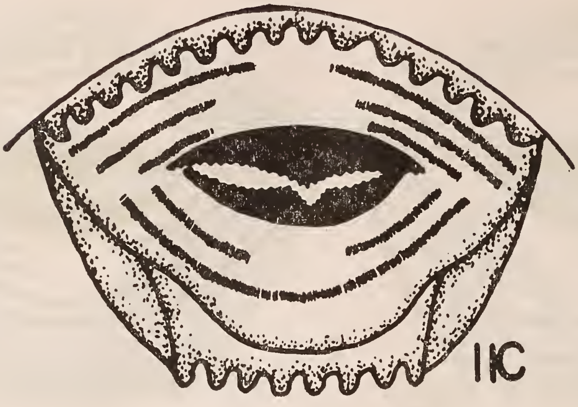
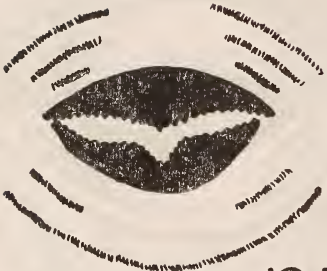

11B

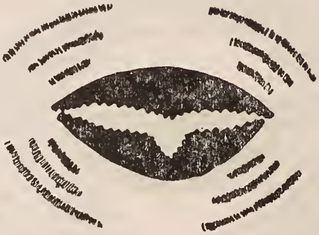
Fig. 8C. Limb paddle with five toes. Fig. 9. Hind limb stage. Fig. 10A and 10B. Well developed hind limb stage. Fig. 11A-B. One fore limb emerged stage.



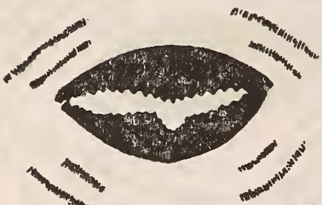
11C



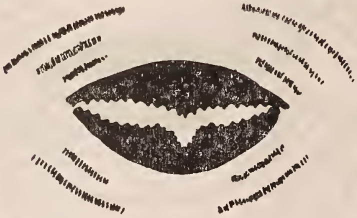
12A



12 B



12C



12D

Fig. 11C. One fore limb emerged stage. Fig. 12A-D. Both limb + tail.

haps because shedding of labial teeth had already started prior to metamorphosis. The rows on the lower jaw varied from 2 to 4 with the last one uninterrupted (Fig. 11A-C).

Both limb + tail:

At this stage more labial teeth were shed which is reflected in the teeth row formula 3(1-3)/0/2/(1), 3(1-3)/0/3(1-3), 3(1-3)|0|2(1-2) or 2(1-2)/0/2(1-2) for this stage (Fig. 12A-D). In all the tadpoles the rows on the upper jaw were interrupted. In six out of ten tadpoles all the rows in the lower jaw were also interrupted (Fig. 12 B-D).

Discussion

There is considerable difference between the observation of this study and that of Agarwal and Niazi(1977). They have mentioned that during external gill stage there is a white beak. In all the earlier literature and in our study the beak was black. When the external gill became covered by the opercular fold on one side, one row of labial teeth in each jaw were observed by Agarwal and Niazi, but we noticed considerable individual variation as had been described earlier. Similarly for the rest of the stages there were individual variations. They had not reported on the teeth structure for feeding and pigmented tail stage. At limb bud stage also there are differences between their observations and the current study. Agarwal and Niazi (1977) reported that from their staging 41-50, the teeth structure remains constant. These stages range from the formation of fourth interdigital indentation to the emergence of fore limbs. However, in the current study considerable variation was seen during these stages. The number of rows reached a maximum when the limbs were well developed. Only three out of five well developed hind limb stages in this study had mouth parts identical to that reported by Agarwal and Niazi (1977). By the time fore limbs appeared, none of the tadpoles examined by us retained the full compliment of teeth as reported by them. The major differences between their study and ours is presented in table 2.

The current study shows that as in the development of temperate anurans, there is ontogenic variation in labial teeth structure. As the number of teeth row structure change with development and even for the same stage of development, the stage of the larvae at which the teeth row formula is determined has to be clearly defined. We noticed that the last two rows of teeth from feeding stage till the beginning of metamorphosis remained uninterrupted. This is in agreement with the diagrams given by Annandale (1917) and McCann (1932). In contrast Kirtisinghe (1957) observed that only the lowermost row of teeth was uninterrupted. Since Kirtisinghe did not specify the populations he examined or the number of tadpoles, it is difficult to assess this difference. Agarwal (1978) and Agarwal and Niazi (1978) were the first to report the ontogeny of labial teeth according to the stage of tadpoles for *R. tigerina.* Since they did not mention the number of tadpoles observed for each stage, the differences could either be due to the lesser number of tadpoles examined by them or due to geographical variation. They examined populations from north India, and this study is based on the population of eastern India. It is possible that environmental factors may influence teeth structure of tadpoles.

Therefore, in this study systematic observation has been done on several individuals from each stage and a range of teeth structure is reported for each stage. This extends the work of earlier workers and provides the first systematic study on the ontogeny of teeth of

R. tigerina and for that matter on only one of several Indian species.

ACKNOWLEDGEMENTS

We wish to thank to Prof. B. K. Behura, Head, P. G. Zoology Department, Utkal University for providing necessary laboratory facilities. One of us (SKD) thanks CSIR for a scholarship.

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A CONTRIBUTION TO THE WETLAND FLORA OF SITAPUR DISTRICT, UTTAR PRADESH[1]

J. K. Maheshwari[2] and R. P. S. Tomar[3]

The paper presents an account of the wetland flora of Sitapur district, Uttar Pradesh. A thorough study of this habitat is of great scientific and economic importance as it supports an appreciable number of endangered species of plants and animals. Further, the wetlands of this district regularly support large number of migratory birds from North European, Arctic and Siberian regions. The district maintains a rich wetland flora and was thoroughly explored during the years 1979-1981. The present study shows that 147 species of angiosperms belonging to 54 families inhabit the lakes, ponds, pools and marshes in the district.

INTRODUCTION

In India the first comprehensive work on the wetland flora was produced by Biswas and Calder (1937). Since then, a number of workers have presented useful and significant data from different parts of the country. There is no floristic record of the species found in the district in Duthie's Flora of Upper Gangetic Plain (1903-1929). Therefore, a research project entitled 'Flora of Sitapur District, Uttar Pradesh' was taken up by us. A thorough study of the present day wetlands is urgently required as this habitat is of great scientific and economic importance and supports an appreciable number of endangered species of plants and animals. The district was, therefore, thoroughly explored during the years 1979-1981 in different seasons. The present study deals with a detailed floristic survey of the wetland plants of the district. The herbarium specimens of wetlands species collected during this study are lodged in the herbarium of National Botanical Research Institute, Lucknow (LWG).

The district forms part of the Lucknow division of Uttar Pradesh and is situated in Gomti-Ghaghra Doab, lying between 27° 6′ and 27° 54′ N and 80° 18′ and 81° 24′ E. It extends approximately 88 km from north to south and 112 km from east to west. It is bounded on the west and south by the river Gomti which meanders from north-west to south-east separating the district from the district of Hardoi and on the east by the river Ghaghra separating the district from the district of Baharaich. The district is bounded on the north by Kheri district and to the south are the districts of Lucknow and Barabanki which lie between rivers Gomti and Ghaghra. The district forms a part of the Gangetic alluvium. It may be roughly divided into western uplands or the *uparhar* and the eastern lowlands or the *ganjar*. The western uplands which cover two-third of the district is a level tract dissected by a number of small streams. The eastern lowlands consist of the Kewani-Chauka and the Chauka-Ghaghra Doab. The water table is high and the exist-

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ence of several rivulets and numerous streams makes it a damp and moist region, requiring no artificial irrigation for cultivation. During the rainy season, the whole of the tract is submerged with water, 15-250 cm deep. The district is traversed by two big rivers, Gomti and Ghaghra which are mostly perennial except in some low-lying areas.

There are large number of *Jhils* (lakes), tanks and ponds with larger stretches of marshy land. The soil is usually an admixture of clay and sand, known as *dumat* which occurs in the major portion of the uplands (*uparhar*). The monsoon normally advances into the district during the later half of June and withdraws early in October. The average annual rainfall for the district is 974.0 mm. A large per cent of the annual rainfall is received during the monsoon period. January is the coldest month of the year with an average minimum temperature of 8°C. The temperature rises rapidly from the month of March. The months of May and early June constitute the hottest period of the year when day temperature may rise up to 46.0°C. During the monsoon and early post-monsoon period, the relative humidity occurs between 70 and 80 per cent. During the summer period air is very dry, particularly in the afternoon when the relative humidity is sometimes less than 30 per cent.

Observations:

The wetland flora of the district shows various types of plant communities and associations. At a number of places, the surface of water is completely covered by plants like *Azolla pinnata* R. Br., *Lemna paucicostata* Hegelm., *Eichhornia crassipes* (Mart.) Solms, *Trapa natans* Linn. var. *bispinosa* (Roxb.) Makino and *Pistia stratiotes* Linn., etc. which form a complete blanket on the surface of water in ponds, pools and ditches at some time during the year.

There are also a number of plant associations, of which the following are frequently noticeable in the district:—

1. Aquatic Habitat: Associations—
   A. *Nelumbo—Nymphaea — Nymphoides*
   B. *Nymphaea — Ludwigia — Eleocharis*
   C. *Sagittaria — Ottelia — Potamogeton*
   D. *Utricularia — Hydrilla — Nymphaea*
2. Marshy Habitats: Associations—
   A. *Eriocaulon — Cyperus — Fimbristylis*
   B. *Ipomoea — Hydrolea — Ammannia*
   C. *Scirpus — Caesulia — Aeschynomene*
   D. *Typha — Phragmites — Scirpus*
   E. *Hygrophila — Eclipta — Alternanthera*
   F. *Bacopa — Marsilea — Monochoria*

ENUMERATION OF THE SPECIES

1. RANUNCULACEAE

1. **Ranunculus sceleratus** Linn. — Occurs commonly in marshy places of the district. Fl. & Fr.: March-June; Local name: Jaldhania; RPST 1030.

2. NYMPHAEACEAE

2. **Nymphaea nouchali** Burm. f. — Occurs commonly in *jhils* and ponds during the rainy season. Fl. & Fr.: Aug.—Oct.; Local name: Kumodini, Kokaveli; RPST 551, 666.

3. **N. stellata** Willd. — Occurs frequently in *jhils* and ponds mixed with *N. nouchali* Burm. f. Fl. & Fr.: Aug.—Oct.; Local name: Kumodini; RPST 828.

3. NELUMBONACEAE

4. **Nelumbo nucifera** Gaertn. — Occurs in *jhils* and ponds during the rainy season. Fl. & Fr.: Aug.—Oct.; Local name: Kamal; RPST 871.

4. BRASSICACEAE

5. **Coronopus didymus** (Linn.) Sm.—Found commonly in fields and open places on moist soil during winter. Fl. & Fr. : Jan.-April; RPST 1026.

5. CARYOPHYLLACEAE

6. **Stellaria media** (Linn.) Vill. — Found commonly in cultivated fields and in other moist waste lands. Fl. & Fr.: Dec.-March; RPST 1132.

6. PORTULACACEAE

7. **Portulaca oleracea** Linn. — Found commonly as a weed in cultivated fields. Fl. & Fr. : Major part of the year; Local name : Kulfa; RPST 1106.
8. **P. quadrifida** Linn. — Found commonly on moist soil in cultivated fields. Fl. & Fr. : July-Sept.; RPST 1199.

7. TAMARICACEAE

9. **Tamarix dioica** Roxb. — Found commonly in low-lying areas and along sandy river banks. Fl. & Fr. : July-Oct.; Local name : Jhau; RPST 109.

8. ELATINACEAE

10. **Bergia ammannioides** Heyne ex Roth — Found commonly in moist waste places. Fl. & Fr. : Nov.-May; RPST 867.

9. STERCULIACEAE

11. **Melochia corchorifolia** Linn. — Found frequently in marshy places. Fl. & Fr. : July-Sept.; RPST 384, 530.
12. **Pentapetes phoenicea** Linn. — Found commonly as a weed in rice fields and marshy places. Fl. & Fr. : Aug.-Nov.; Local name : Guldupahri; RPST 337.

10. TILIACEAE

13. **Corchorus aestuans** Linn.—Occurs commonly in moist shady places. Fl. & Fr. : Aug.-Nov.; RPST 903.
14. **C. capsularis** Linn. — Found commonly on moist ground. Fl. & Fr. : July-Sept.; Local name : Jute; RPST 989.
15. **C. olitorius** Linn. — Found commonly in moist shady places in cultivated fields and fallow grounds. Fl. & Fr. : Sept.-Oct.; Local name : Jute; RPST 502.

11. FABACEAE

16. **Aeschynomene aspera** Linn. — Found frequently in paddy fields and swampy places. Fl. & Fr. : July-Nov.; RPST 919.
17. **A. indica** Linn. — Occurs commonly in paddy fields and water-logged areas. Fl. & Fr. : July-Nov.; RPST 111.
18. **Derris indica** (Lamk.) Bennet syn. *Pongamia pinnata* (L.) Pierre — Found frequently near rivers, canals and in moist localities. Fl. & Fr. : Dec.-June; RPST 833.
19. **Desmodium triflorum** (Linn.) DC. — Occurs along the banks of canals. Fl.: July-Sept., Fr.: Nov.-Jan.; RPST 107.
20. **Sebania bispinosa** (Jacq.) W.F. Wight — Common along canal banks and also in cultivated fields and swampy places. Fl. & Fr.: Sept.-Oct.; Local name: Dhaincha; RPST 506, 1060.

12. CAESALPINIACEAE

21. **Cassia tora** Linn. — A dominant weed of rainy season; found commonly along

roadsides, railway tracks and in waste grounds. Fl. & Fr.: Aug.-Nov.; Local name: Panwar; RPST 314.

13. ROSACEAE

22. **Potentilla supina** Linn. — Occurs commonly in marshy and muddy places. Fl. & Fr.: Jan-April; RPST 1952.

14. MYRTACEAE

23. **Syzygium heyneanum** (Duthie) Wall. ex Gamble — A small tree, found frequently along nallahs, perennial ponds and banks of rivers. Fl. & Fr.: April-Sept.; Local name: Kath-Jammuni; RPST 1140.

15. LECYTHIDACEAE

24. **Barringtonia acutangula** (Linn.) Gaertn. —Found rarely in swampy areas and near riverbanks and *jhils.* Fl. & Fr.: May-Nov.; Local name: Sindaroukh; RPST 1248.

16. LYTHRACEAE

25. **Ammannia baccifera** Linn.—Found commonly in paddy fields and marshy depressions. Fl. & Fr.: Aug.-Dec.; RPST 623.
26. **A. multiflora** Roxb. — Occurs frequently in marshy places and paddy fields. Fl. & Fr.: Aug.-Nov.; RPST 348, 543.

17. ONAGRACEAE

27. **Ludwigia octovalvis** (Jacq.) Raven ssp. **sessiliflora** (Mich.) Raven — Found frequently in marshy areas. Fl. & Fr.: Oct.-Dec.; RPST 687.
28. **L. perennis** Linn. — Occurs commonly as a weed in damp and shady places. Fl. & Fr.: Sept.-Nov.; RPST 659.

18. TRAPACEAE

29. **Trapa natans** Linn. var. **bispinosa** (Roxb.) Makino— Commonly cultivated in *jhils* and ponds in the area. Fl. & Fr.: Aug-Nov.; Local Name: Singhara; RPST 283, 553.

19. MOLLUGINACEAE

30. **Glinus lotoides** Linn. — Occurs commonly in dried up ponds, puddles and in moist sandy places. Fl. & Fr.: April to Aug.; RPST 1083.
31. **G. oppositifolius** (Linn.) DC. — Found commonly on moist soil of fallow and cultivated fields. Fl. & Fr.: July-Sept.; RPST 432.
32. **Mollugo pentaphylla** Linn. — Found frequently in the area, mostly in damp, shady places; also found in agricultural fields. Fl. & Fr.: Aug.-Oct.; RPST 514.

20. APIACEAE

33. **Centella asiatica** (Linn.) Urban—Occurs commonly in moist shady places and along river banks. Fl. & Fr.: April-Aug.; Local name: Brahmi; RPST 1033.

21. RUBIACEAE

34. **Borreria articularis** (Linn. f.) F.N. Williams — Occurs commonly in marshy places. Fl. & Fr.: Aug.-Oct.; RPST 434.
35. **B. hispida** K. Schum. — Found commonly as a weed in cultivated and unused grounds on damp, sandy soil. Fl. & Fr.: Aug.-Oct.; RPST 412.

36. **Oldenlandia corymbosa** Linn. — Occurs frequently in fields and waste places on moist ground. Fl. & Fr.: Sept.-Oct.; RPST 169, 658.

37. **O. nudicaulis** Roth — Found frequently in moist waste grounds. Fl. & Fr.: Aug.-Oct.; RPST 735.

22. ASTERACEAE

38. **Ageratum conyzoides** Linn. — Common along the banks of canals and irrigation channels. Fl. & Fr.: Nov.-June; RPST 103, 537.

39. **Caesulia axillaris** Roxb. — Found commonly in paddy fields and marshy places. Fl. & Fr.: Sept-April; RPST 119, 611.

40. **Eclipta prostrata** (Linn.) Linn. — Occurs commonly in marshes, swamps and riversides. Fl. & Fr.: Major Part of the year; Local name: Bhringraj; RPST 295, 738.

41. **Gnaphalium polycaulon** Pers. — Found frequently in moist, waste, shady places. Fl. & Fr.: Feb.-April; RPST 775.

42. **G. pulvinatum** Del. — Occurs commonly in moist, shady, waste places. Fl. & Fr.: Jan.-March; RPST 581.

43. **Grangea maderaspatana** (Linn.) Poir. — Found commonly in marshy places and along irrigation channels, puddles etc. Fl. & Fr.: Oct.-March; RPST 210.

44. **Xanthium strumarium** Linn. — Found commonly in the seasonal marshes of temporary pools. Fl. & Fr.: Sept.-June; Local name: Gokharu; RPST 559.

23. SPHENOCLEACEAE

45. **Sphenoclea zeylanica** Gaertn. — Found commonly in paddy fields and swampy areas. Fl. & Fr.: Aug.-Nov.; RPST 912.

24. MENYANTHACEAE

46. **Nymphoides cristata** (Roxb.) Kuntze — Found commonly in *jhils* and ponds, etc. Fl. & Fr.: Rainy season and early winter; RPST 663, 876.

47. **N. indica** (Linn.) Kuntze — Occurs commonly in *jhils,* ponds, etc. Fl. & Fr.: April-Oct.; RPST 872.

25. HYDROPHYLLACEAE

48. **Hydrolea zeylanica** (Linn.) Vahl—Occurs commonly as a weed in paddy fields and marshy places. Fl. & Fr.: Sept.-Dec.; RPST 918.

26. BORAGINACEAE

49. **Cynoglossum zeylanicum** (Hornem.) Thunb. ex Lehm. — Found occasionally on moist soil in wastelands. Fl. & Fr.: Oct.-Jan.; RPST 37.

50. **Heliotropium strigosum** Willd. — Found commonly on moist ground. Fl. & Fr.: July-March; RPST 436.

27. CONVOLVULACEAE

51. **Ipomoea aquatica** Forsk. — Occurs commonly in ponds, pools, canals, ditches, muddy grounds and agricultural fields. Fl. & Fr.: Sept.-Feb.; Local name: Karamua, Nari ka saag; RPST 328.

52. **Volvulopis nummularia** (Linn.) Roberty —Found frequently in muddy and moist places. Fl. & Fr.: August-February; Local name: Shankh-pushpi; RPST 527.

28. SOLANACEAE

53. **Physalis minima** Linn. — Found commonly in moist shady places and wastelands. Fl. & Fr.: July-Jan.; Local name: Jangli Makoiya; RPST 982.

54. **Solanum nigrum** Linn. — Occurs frequently in moist shady places. Fl. & Fr. : Most part of the year; Local name : Makoiya; RPST 1117.

29. SCROPHULARIACEAE

55. **Bacopa monnieri** (Linn.) Wettst. — Occurs commonly in marshy or wet places near canals, ponds and *jhils.* Fl. & Fr. : Aug.-Nov.; RPST 272.

56. **Limnophila indica** (Linn.) Druce — Found frequently in shallow ponds, pools and ditches. Fl. & Fr. : Sept.-Dec.; RPST 683.

57. **Lindernia anagallis** (Burm. f.) Penn. — Occurs commonly in marshy and swampy areas. Fl. & Fr. : Sept.-Dec.; RPST 660.

58. **L. ciliata** (Colsm.) Penn. — Found commonly in paddy fields near canals and irrigation channels. Fl. & Fr. : Sept.-Dec.; RPST 657, 979.

59. **L. crustacea** (Linn.) F. Muell. — Occurs commonly in paddy fields and moist situations. Fl. & Fr. : Sept.-Dec.; RPST 395, 513.

60. **Mazus delavayi** Bonati — Found occasionally in moist shady places. Fl. & Fr. : Sept.-Dec.; RPST 118.

61. **M. pumilus** (Burm. f.) Steen. — Occurs frequently in wet or damp, shady places and along the banks of canals. Fl. & Fr. : Sept.-Feb.; RPST 980.

62. **Striga angustifolia** (D. Don) Sald. — Found commonly near the banks of ponds and pools. Fl. & Fr. : Sept.-Nov.; RPST 538.

63. **Verbascum chinense** (Linn.) Sant. — Occurs commonly in moist, shady places along the banks of irrigation channels. Fl. & Fr. : Feb.-April; RPST 1012.

64. **Veronica anagallis-aquatica** Linn. — Occurs commonly in marshy places. Fl. & Fr. : Feb.-April; RPST 1013, 1048.

30. LENTIBULARIACEAE

65. **Utricularia stellaris** Linn. — An insectivorous, free floating plant; found commonly in ponds and pools. Fl. & Fr. : Sept.-Nov.; RPST 669, 890.

66. **U. flexuosa** Vahl — Found frequently in *jhils,* ponds and pools. Fl. & Fr. : Sept.-Jan.; RPST 858.

31. ACANTHACEAE

67. **Hygrophila auriculata** (Schum.) Heine— Found commonly in marshy places and near ponds and roadside ditches. Fl. & Fr. : Oct.-Dec.; RPST 624, 641.

68. **H. polysperma** (Roxb.) T. Anders. — Found commonly in marshy and swampy areas. Fl. & Fr. : Sept.-March; RPST 385.

69. **Rostellularia quinqueangularis** (Koenig ex Roxb.) var. **peploides** Nees — Found commonly in the ground vegetation of fruit orchards, on moist soil. Fl. & Fr. : Sept.-Feb.; RPST 379.

32. VERBENACEAE

70. **Phyla nodiflora** (Linn.) Greene — Occurs commonly in marshy places and along irrigation channels. Fl. & Fr. : April-Aug.; RPST 172, 375.

33. LAMIACEAE

71. **Anisomeles indica** (Linn.) Kuntze — Found commonly on moist soil of orchards or along canal banks. Fl. & Fr. : Sept.-Feb.; RPST 592, 674.

72. **Salvia plebeia** R. Br. — Occurs commonly in moist places. Fl. & Fr. : Sept.-April; RPST 774, 1069.

34. AMARANTHACEAE

73. **Alternanthera paronychioides** St. Hill. — Occurs commonly in marshy places. Fl. & Fr.: throughout the year; RPST 344.

74. **A. sessilis** (Linn.) R. Br. ex DC. — Occurs commonly in moist situations. Fl. & Fr.: Throughout the year; RPST 110, 579.

35. CHENOPODIACEAE

75. **Chenopodium ambrosioides** Linn. — Found commonly in moist localities. Fl. & Fr.: March-Sept.; RPST 796.

36. POLYGONACEAE

76. **Polygonum barbatum** Linn. ssp. **gracile** Danser — Found commonly in marshes and along canal banks. Fl. & Fr.: Sept.-March; RPST 133.

77. **P. glabrum** Willd. — Found commonly in marshes and along canal banks. Fl. & Fr.: Sept.-March; RPST 116.

78. **P. plebeium** R. Br. — Occurs commonly in moist shady places. Fl. & Fr.: Aug.-April; RPST 120, 737.

79. **Rumex dentatus** Linn. — Found commonly in marshy places and along river banks. Fl. & Fr.: Dec-June; RPST 112, 821.

37. EUPHORBIACEAE

80. **Euphorbia geniculata** Orteg. — Found commonly in moist shady places. Fl. & Fr.: Dec.-April; RPST 1141.

81. **E. hypericifolia** Linn. — Occurs commonly along river banks and in waste lands in moist situations. Fl. & Fr.: May-Oct; RPST 365.

82. **Kirganelia .reticulata** (Poir.) Baill. — Occurs commonly along irrigation channels and in marshy areas. Fl. & Fr.: April-July; RPST 515.

83. **Trewia polycarpa** Benth. — Occurs commonly in marshy places along river beds. Fl. & Fr.: Feb.-April; RPST 191.

38. URTICACEAE

84. **Fleurya interrupta** (Linn.) Gaud.—Found occasionally in damp, wet places near orchards. Fl. & Fr.: Sept.-Nov.; RPST 997.

39. CERATOPHYLLACEAE

85. **Ceratophyllum demersum** Linn.—Occurs commonly in rivers, *jhils* and ponds. Fl. & Fr.: Sept.-Nov.; RPST 664.

MONOCOTYLEDONS

40. HYDROCHARITACEAE

86. **Hydrilla verticillata** (Linn. f.) Royle — Found abundantly in ponds and ditches. Fl. & Fr.: Sept.-Nov.; RPST 859.

87. **Ottelia alismoides** (Linn.) Pers. — Found commonly in ponds, pools and roadside ditches. Fl. & Fr.: Sept.-Dec.; RPST 661.

88. **Nechamandra alternifolia** (Roxb.) Thw. —Occurs commonly in ponds, pools and ditches. Fl. & Fr.: Sept.-Oct.; RPST 864.

89. **Vallisneria spiralis** Linn. — Found frequently in ponds, pools and shallow-river ditches. Fl. & Fr.: Oct-Feb.; RPST 143.

41. ORCHIDACEAE

90. **Zeuxine strateumatica** (Linn.) Schl. — Occurs rarely in moist turfy banks of canals. Fl. & Fr.: Feb.-March; RPST 750.

42. AMARYLLIDACEAE

91. **Crinum defixum** Ker-Gawler — Occurs commonly in swamps, along streams and ponds. Fl. & Fr.: June-Oct.; Local name: Kalakandera; RPST 1279.

43. LILIACEAE

92. **Asparagus racemosus** Willd. — Found commonly in moist waste places. Fl. & Fr.: Nov.-Jan.; Local name: Satawar; RPST 1039.

44. PONTEDERIACEAE

93. **Eichhornia crassipes** (Mart.) Solms — Found commonly in *jhils,* ponds and pools forming dense patches. Fl. & Fr.: Aug.-Nov.; Local name: Jal Kumbhi; RPST 550.
94. **Monochoria vaginalis** (Burm. f.) Presl—Occurs commonly in marshes and roadside ditches. Fl. & Fr.: Sept.-Nov.; PRST 851.

45. COMMELINACEAE

95. **Amischophacelus axillaris** (Linn.) R. & K. — Found commonly in damp, swampy soils of waste lands. Fl. & Fr.: Aug.-Dec.; RPST 874.
96. **Commelina benghalensis** Linn. — Found commonly in marshes and along canal banks. Fl. & Fr.: Aug.-Nov.; RPST 552, 976.
97. **Murdannia nudiflora** (Linn.) Brenan — Occurs frequently in moist soil of cultivated fields. Fl. & Fr.: Aug.-Nov.; RPST 345.

46. TYPHACEAE

98. **Typha angustata** Bory & Chaub. — Found commonly in marshes and swamps. Fl. & Fr.: May-Nov.; Local name: Gondi; RPST 665.

47. ARACEAE

99. **Pistia stratiotes** Linn. — Occurs rarely in still water of pools and ditches. Fl. & Fr.: Aug-Nov.; RPST 327.

48. LEMNACEAE

100. **Lemna paucicostata** Hegelm. — Occurs frequently in ponds and ditches. RPST 843.
101. **Spirodela polyrrhiza** (Linn.) Schleid. — Found commonly in still water of ponds and ditches. RPST 842.
102. **Wolffia arrhiza** (Linn.) Horkel ex Wimm. —Found occasionally in ponds and ditches. RPST 836.

49. ALISMATACEAE

103. **Sagittaria guayanensis** H. B. & K. ssp. **lappula** (D. Don). Bogin — Found commonly in ponds, pools and roadside ditches; also seen in flooded paddy fields. Fl. & Fr.: Aug.-Dec.; RPST 840, 877.
104. **S. trifolia** Linn. — Found occasionally in marshy places. Fl. & Fr.: Sept.-Dec.; RPST 988.

50. APONOGETONACEAE

105. **Aponogeton natans** (Linn.) Engl. & Krause — Found rarely in still water of roadside pools and ditches. Fl. & Fr.: Aug-Dec.; RPST 844.

51. POTAMOGETONACEAE

106. **Potamogeton crispus** Linn. — Found frequently in shallow, temporary water ponds and pools. Fl. & Fr.: Dec.-April; RPST 1034.
107. **P. nodosus** Poir. — Found commonly in ponds and ditches. Fl. & Fr.: Nov.-Dec.; RPST 946.
108. **P. pectinatus** Linn. — Occurs commonly in ponds and pools etc. Fl. & Fr.: Oct.-April; RPST 1036.

52. ERIOCAULACEAE

109. **Eriocaulon cinereum** R. Br. — Found commonly in marshy places and paddy fields. Fl. & Fr. : Sept-Dec.; RPST 999.

53. CYPERACEAE

110. **Cyperus alopecuroides** Rottb. — Found commonly along the banks of streams and other irrigation channels. Fl. & Fr. : Aug.-Nov.; RPST 253.

111. **C. alulatus** Kern — Found commonly in paddy fields and other marshy places. Fl. & Fr. : Sept.-Nov.; RPST 362.

112. **C. brevifolius** (Rottb.) Hassk. — Found frequently in marshy and muddy places. Fl. & Fr. : July-Oct.; RPST 339.

113. **C. compactus** Retz. — Found commonly in marshy places. Fl. & Fr. : Aug.-Nov.; RPST 616.

114. **C. compressus** Linn. — Occurs commonly in marshy places. Fl. & Fr. : Aug.-Nov.; RPST 464.

115. **C. difformis** Linn. — Occurs commonly in swampy and marshy places. Fl. & Fr. : Aug.-Dec.; RPST 335, 625.

116. **C. digitatus** Roxb. — Occurs commonly in paddy fields and swampy areas. Fl. & Fr. : Aug.-Dec.; RPST 952.

117. **C. exaltatus** Retz. — Found frequently in marshy places. Fl. & Fr. : Aug.-Dec.; RPST 274.

118. **C. iria** Linn. — Found commonly in paddy fields and other marshy places. Fl. & Fr. : Aug.-Nov; RPST 547.

119. **C. kyllingia** Endl. — Found commonly in paddy fields and other marshy places. Fl. & Fr. : Aug.-March; RPST 354.

120. **C. rotundus** Linn. — Found commonly in paddy fields and other swampy areas in open grasslands. Fl. & Fr. : July-Dec.; RPST 361, 549.

121. **C. triceps** (Rottb.) Endl. — Occurs commonly in marshy places. Fl. & Fr. : Aug.-March; RPST 138.

122. **Eleocharis atropurpurea** (Retz.) Kunth—Occurs commonly in paddy fields and other marshy places. Fl. & Fr. : Sept.-Dec.; RPST 122.

123. **Fimbristylis bisumbellata** (Forsk.) Bub. —Found commonly as a weed in paddy fields and swampy localities. Fl. & Fr. : Nov.-May; RPST 271, 626.

124. **F. falcata** (Vahl) Kunth — Occurs commonly in grasslands and river beds. Fl. & Fr. : Sept.-Dec.; RPST 423.

125. **F. littoralis** Gaud. — Found commonly in paddy fields and marshy areas. Fl. & Fr. : Sept.-Dec.; RPST 545.

126. **F. miliacea** (Linn.) Vahl—Occurs commonly in paddy fields and marshy areas. Fl. & Fr. : Aug.-Nov.; RPST 376.

127. **F. ovata** (Burm.) Kern — Found commonly in cultivated fields. Fl. & Fr. : Aug.-Dec.; RPST 291, 354.

128. **Scirpus articulatus** Linn. — Found commonly in paddy fields and marshy areas. Fl. & Fr. : Sept.-Nov.; RPST 130, 898, 1082.

129. **S. mucronatus** Linn. — Found occasionally in marshy areas. Fl. & Fr. : Sept.-Dec.; RPST 222.

130. **S. squarrosus** Linn. — Found commonly in paddy fields after harvest. Fl. & Fr. : Oct.-Dec.; RPST 378.

131. **S. tuberosus** Desf. — Found commonly in paddy fields and marshy areas. Fl. & Fr. : Sept.-Dec.; RPST 333.

54. POACEAE

132. **Arundo donax** Linn. — Found frequently along ditches and streams. Fl. & Fr. : Sept.-Feb.; RPST 972.

133. **Brachiaria reptans** (Linn.) Gardn. & Hubb. — Found frequently in marshy places. Fl. & Fr.: Sept.-Jan.; RPST 533.
134. **Coix lacryma-jobi** Linn. — Found commonly in moist soil near irrigation canals. Fl. & Fr.: Sept.-Feb.; RPST 273.
135. **Echinochloa colonum** (Linn.) Link — Found commonly in paddy fields and other marshy places. Fl. & Fr.: July-Nov.; RPST 304, 360.
136. **E. crusgalli** (Linn.) Beauv. — Occurs commonly in paddy fields and swampy areas near ponds and pools. Fl. & Fr.: Aug.-Nov.; RPST 338.
137. **Eragrostis tenella** (Linn.) P. Beauv. ex Roem. & Schult. — Found commonly on moist soil near ponds and pools. Fl. & Fr.: Aug.-Dec.; RPST 387, 531.
138. **Imperata cylindrica** (Linn.) Beauv. — Found commonly in open fields on moist ground. Fl. & Fr.: June-Oct.; RPST 156, 252, 451.
139. **Ischaemum rugosum** Salisb. — Found commonly in paddy fields and near ponds and pools. Fl. & Fr.: Sept-Dec.; RPST 539.
140. **Oryza rufipogon** Griff. — Occurs commonly in marshy places. Fl. & Fr.: Oct.-Nov.; Local name: Tinna, Pasai; RPST 38.
141. **Paspalum distichum** Linn. — Occurs commonly in marshy places and paddy fields. Fl. & Fr.: July-Sept.; RPST 341.
142. **Perotis indica** (Linn.) Kuntze — Found commonly in damp, shady places near ponds and pools. Fl. & Fr.: July-Nov.; RPST 981.
143. **Phragmites maxima** (Forrsk.) Blatt. & McC.— Occurs commonly in marshy places along streams. Fl. & Fr.: Oct.-Jan.; RPST 957.
144. **Saccharum bengalense** Retz. — Found frequently in marshy places and on the bunds of fields. Fl. & Fr.: Sept.-Nov.; Local name: Munj; RPST 39.
145. **S. spontaneum** Linn. — Found frequently along river banks in swampy areas and on the bunds of fields. Fl. & Fr.: Sept.-Jan.; RPST 332.
146. **Sorghum halepense** (Linn.) Pers. — Found commonly along the irrigation channels. Fl. & Fr.: Sept-Dec.; RPST 734.
147. **Vetiveria zizanioides** (Linn.) Nash — Occurs commonly in marshy places. Fl. & Fr.: July-Nov.; Local name: Seenk, khas; RPST 366, 684.

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STUDIES ON THE SYSTEMATICS AND DISTRIBUTION OF CRABS IN ASSAM[1]

N. K. DUTTA[2]

(*With six text-figures*)

The family Potamonidae (Decapoda: Crustacea) of Assam has *Potamon* (*Acanthotelphusa*) *woodmasoni* Rathbun of the genus *Potamon* and five species of the genus *Paratelphusa* namely *Paratelphusa* (*Barytelphusa*) *edentula* Alcock, *P.* (*Barytelphusa*) *guerini* var. *planata* A.M. Edw., *P.* (*Barytelphusa*) *harpx* Alcock, *P.* (*Paratelphusa*) *sinensis* Milne-Edw., *P.* (*Paratelphusa*) *spinigera* Woodmason of family Potamonidae = T.(h.) *elphusidae* are recorded from different districts of Assam.

INTRODUCTION

One of the most important aspects of fishery biology is the fishery of edible crustaceans. Among the crustacean fishery, crab fishery has gained considerable attention particularly the biology and fishery of crabs that are of economic importance. Crabs are caught round the year. However, the peak catch season shows a definite seasonal trend in commercially important crab landing areas. On the North Eastern region of India in general and Assam in particular, the peak season is generally from October to February.

There is little information on the freshwater crabs of Assam. In view of the regional importance of the fishery of these crabs the present study was undertaken.

MATERIAL AND METHODS

The species of crabs belonging to family Potamonidae (Telphusidae) of Assam were collected regularly from different regions of the districts of the state, and were obtained as well from fishermen's catch. These were brought to the laboratory, cleaned and preserved in 8-10% formaldehyde solution.

RESULTS

The collection comprises of six species:

Paratelphusa (Barytelphusa) edentula Alcock. (Fig. 1).

Collection localities:

Goalpara district: Boko, 1 ♂, TL. 25 mm; Kamrup district: Maligaon, 2 ♂, TL. 28 mm; Sibsagar district: Panbesa near Sibsagar, 1 ♂ 2 ♀, TL. 26-31 mm; Lakhimpur district: Corella beel, 3 ♂, TL. 15-25 mm; Dibrugarh district: Dibrugarh, 4 ♂, TL. 20-33 mm.

Diagnostic features:

The cervical groove is broad and deep running to the lateral epibranchial tooth. The epigastric is broad and blunt. The outer half of the post orbital portion of the epigastric crest is sharp and inner portion is blunt. The legs are strong and shorter than smaller cheliped. In the chelate leg, one pair of blunt tooth like projection in the antero-lateral portion of ischium and merus and one large and two blunt teeth on carpus.

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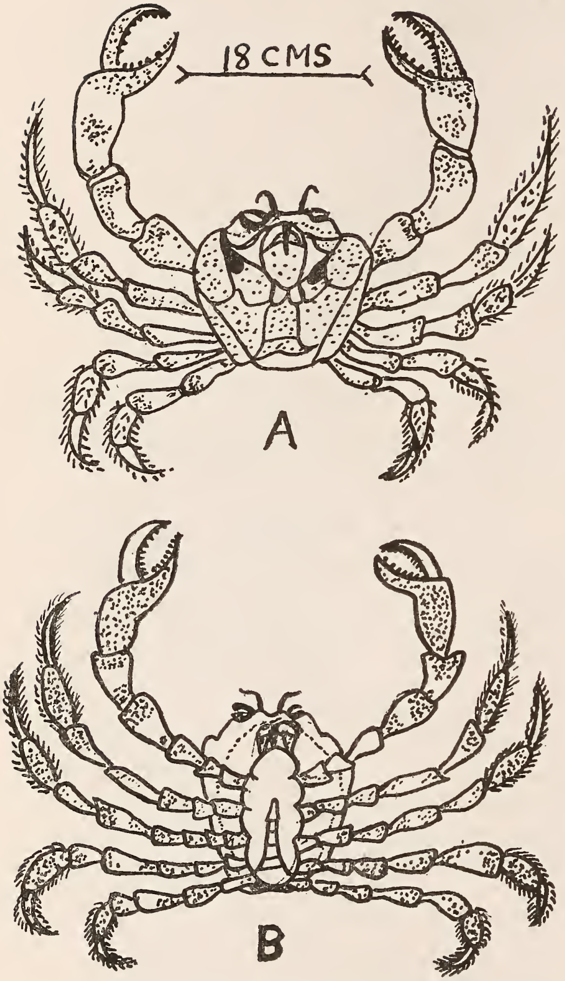

Fig. 1. *Paratelphusa (Barytelphusa) edentula* Alcock. A. Dorsal side; B. Ventral side.

Maximum size 29 mm.

In Assam, the species has been so far recorded from Sibsagar district. The present collection extends its distribution to Goalpara, Kamrup, Lakhimpur and Dibrugarh districts.

Paratelphusa (Barytelphusa) guerini var. **planata** A.M.-Edw. (Fig. 2).

Collection localities: Kamrup district: Tihu, 3 ♂, 1 ♀, TL. 68-79 mm; Darrang district: Mora-Dhansiri, 1 ♂, TL. 74 mm; Karbi Anglong district: R. Rabinala, 1 ♂, TL. 73 mm; Garo Hills: Garo Hill, 2 ♂, TL. 25-65 mm.

Diagnostic features:

The cervical groove is broad and deep, running towards, but not reaching the site of the lateral-epibranchial tooth. The epigastric and post orbital crests form a bold ridge on either side of the mesogastric furrow. In the chelate leg, the pits are linearly arranged on the fingers and there are some squami-form tubercles on the upper surface of the palm.

Maximum size 74 mm.

Paratelphusa (Barytelphusa) harpax Alcock (Fig. 3).

Collection localities: Sibsagar district: Puronipukhuri beel near Gaurisagar, 2 ♂, TL. 15-35 mm; Lakhimpur district: North Lakhimpur, 2 ♂, TL. 15-36 mm; Dibrugarh district: Proper Dibrugarh near Assam Medical College, 2 ♀, TL. 55 mm.

Diagnostic features:

The cervical groove is deep and so the region appears more convex. In the orbital border of the carapace, 3-4 distinct teeth are present and the rest of the area in the form of a serrated structure. The sixth segment of the abdomen is longer and its sides are more concave. The postero-lateral borders of the carapace are also distinctly serrated.

Maximum size 55 mm.

Paratelphusa (Paratelphusa) sinensis Edw. (Fig. 4).

Collection localities: Kamrup district: R. Pagladia near Uttarkuchi, 1 ♂, 1 ♀, TL. 13-15 mm; Darrang district: Proper Tezpur, 2 ♂,

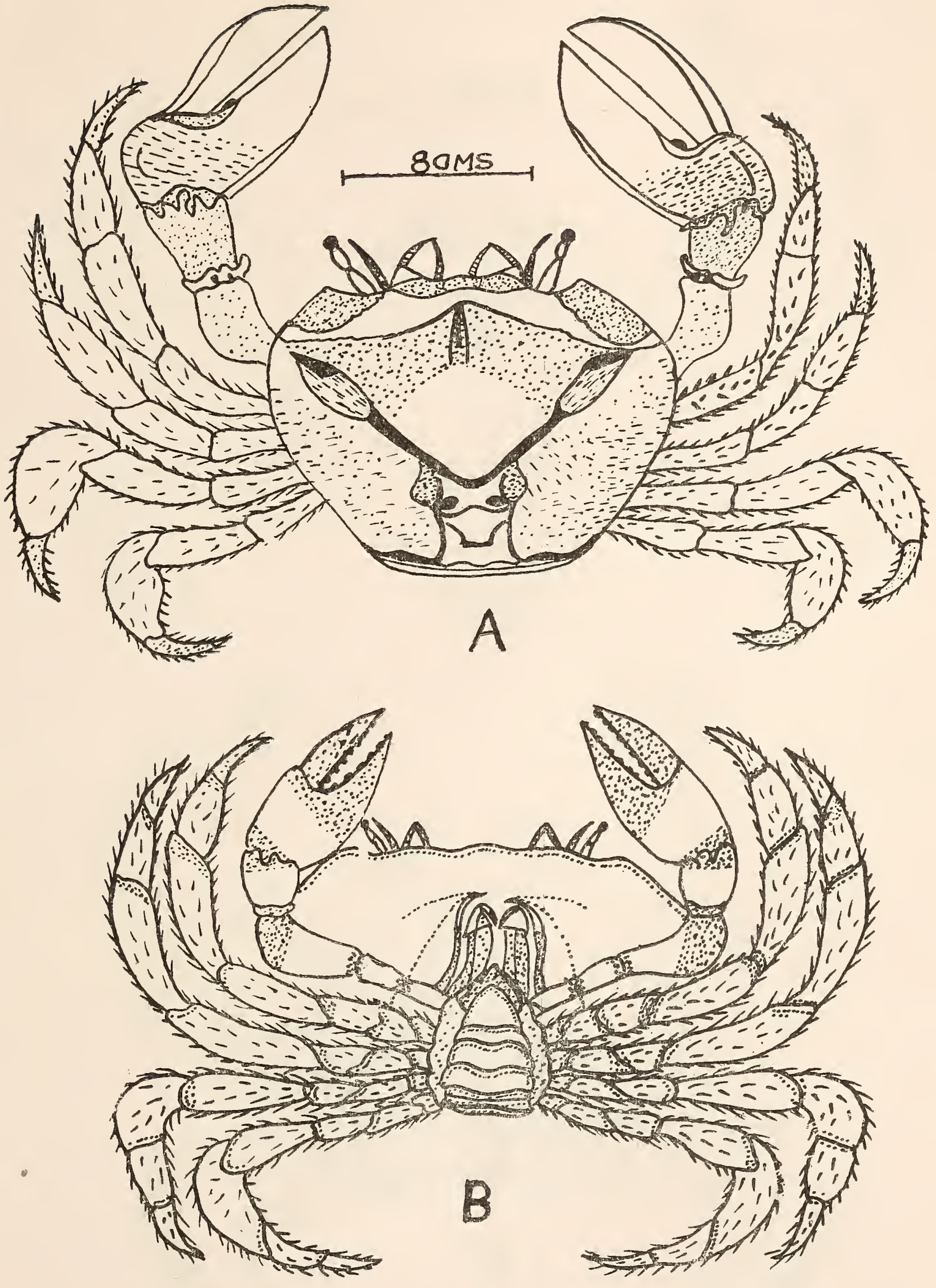

Fig. 2. *Paratelphusa* (*Barytelphusa*) *guerini* var. *planata* A.M.-Edw.
A. Dorsal side; B. Ventral side.

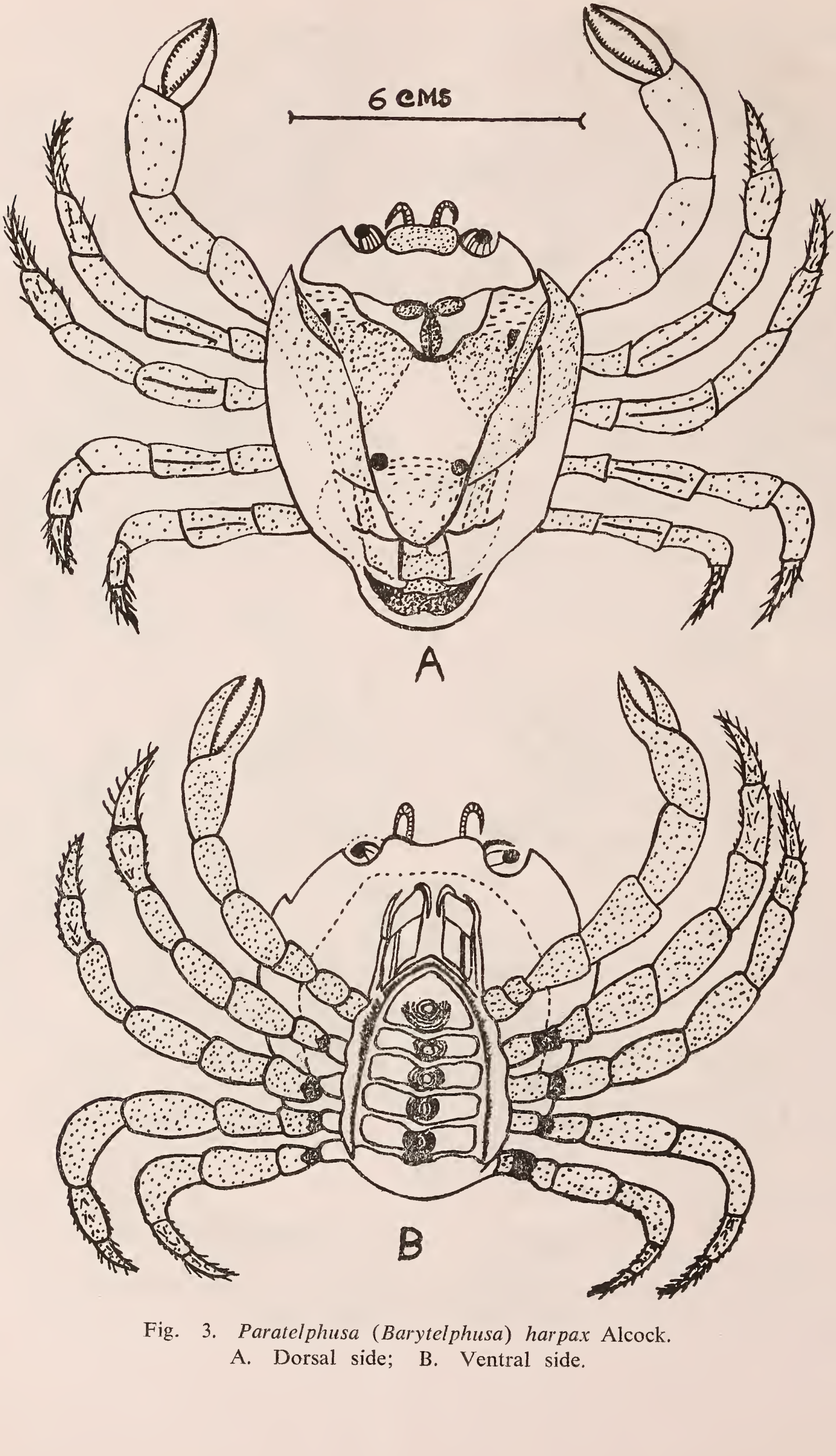

Fig. 3. *Paratelphusa* (*Barytelphusa*) *harpax* Alcock.
A. Dorsal side; B. Ventral side.

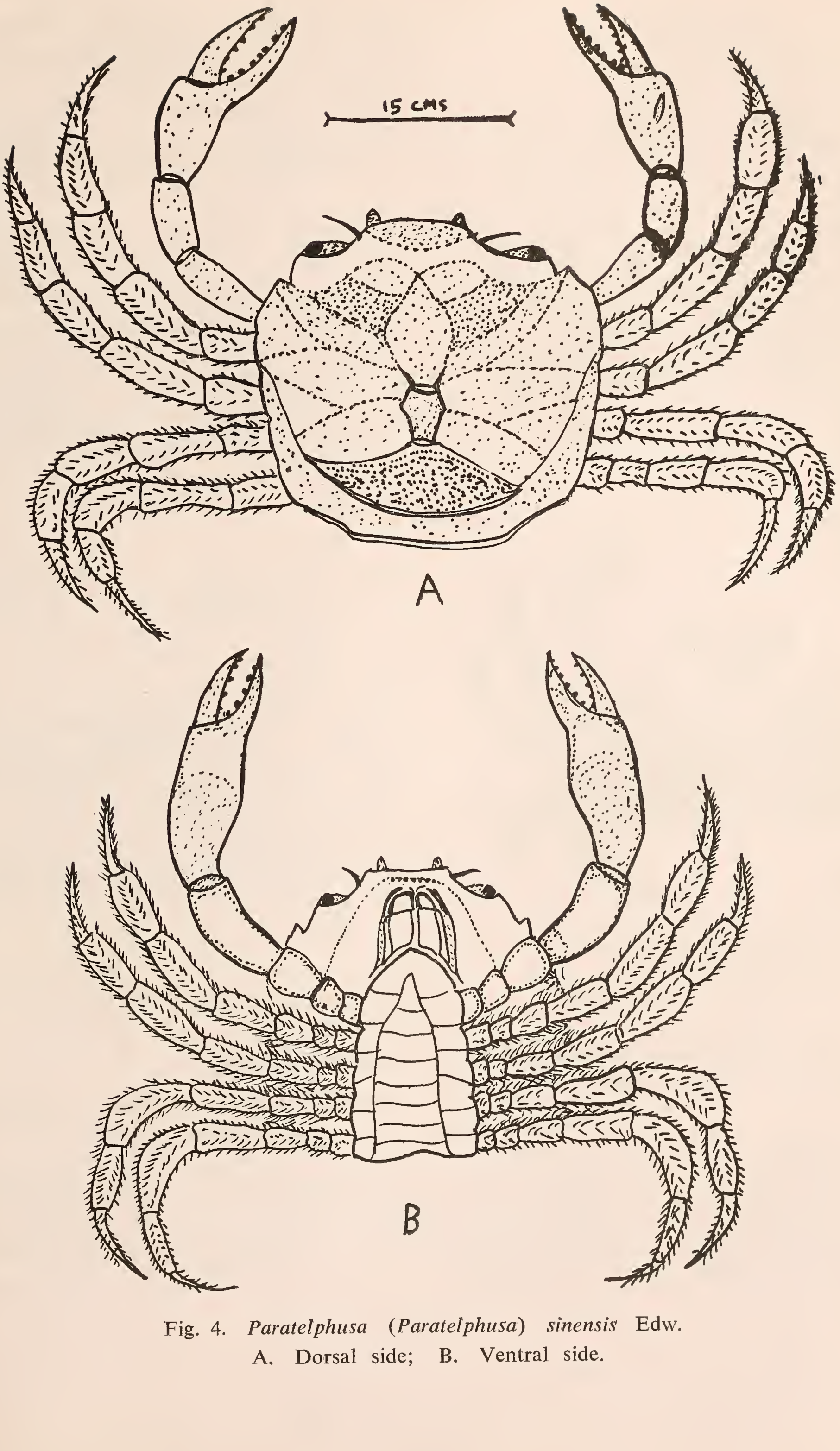

Fig. 4. *Paratelphusa* (*Paratelphusa*) *sinensis* Edw.
A. Dorsal side; B. Ventral side.

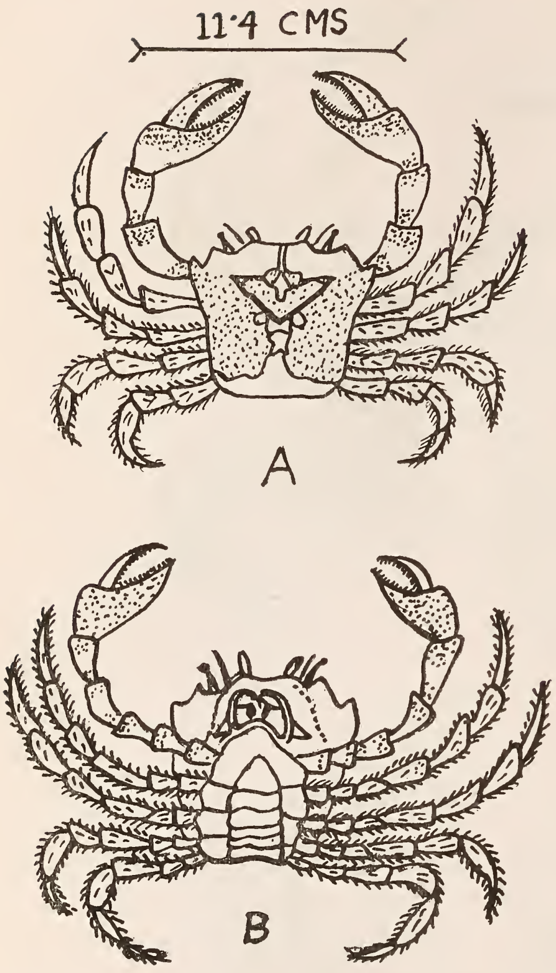

Fig. 5. *Paratelphusa (Paratelphusa) spinigera* Woodmason.
A. Dorsal side; B. Ventral side.

2 ♀, TL. 16-20 mm; Karbi Anglong district: Proper Diphu, 1 ♂, TL. 14 mm.

Diagnostic features:

The cervical groove is just visible but is very superficial and indistinctly represented by a line of irregular pits. The post-frontal mesogastric groove is indistinct. The epigastric crests are slightly overlapping. The post orbital crests distinct and sharp at their inner edge and blunt behind the orbit.

Maximum size 15 mm.

Paratelphusa (Paratelphusa) spinigera Woodmason (Fig. 5).

Collection Localities: Goalpara district: Dipo, 2 ♂, 2 ♀, TL. 51-52 mm; Kamrup district: Kukurmara beel, Lankeswar dhum near Jalukbari. Boko, Bebejapara near Bozali, Bhulukmara beel near Nalbari, Sundubi beel, Golah beel near Amingaon, Durmari beel near Chetoli, Gogiakur near R. Saulkhua, Mongoldoi, Kahi Kuchi, R. Kulsi, 25 ♂, 6 ♀, TL. 55-57 mm; Nowgong district: Hapakati beel, Khetri near Jagiroad, R. Kolong, R. Kopili near Morigaon, 5 ♂, 2 ♀, TL. 45-50 mm; Karbi-Anglong district: R. Jamuna, 2 ♂, 1 ♀, TL. 35-45 mm; Cachar district: R. Karimganj, 3 ♂, 1 ♀, TL. 35-40 mm; Sibsagar district: Nawpukhuri beel, R. Namdang near Joysagar, Jorhat, Golaghat, Bokakhat, Gorisagar, Sunari, 5 ♂, 8 ♀, TL. 45-56 mm; Lakhimpur district: Pohumara near Singar, North Lakhimpur, 4 ♂, 4 ♀, TL. 35-42 mm; Dibrugarh district: 2 ♂, 1 ♀, TL. 31-40 mm.

Diagnostic features:

The deep cervical groove runs towards the outer end of the post-orbital crests, but becomes quite indistinct behind them. The epigastric crest is prominent but becomes indistinct beyond the point where the cervical groove approaches them.

Maximum size 57 mm.

Potamon (Acanthotelphusa) woodmasoni Rathbun (Fig. 6).

Collection Localities: Kamrup district: Borpeta and Bozali, 2 ♂, TL. 32-33 mm. Sibsagar district: R. Namdang near Bahbariting, 4 ♂, 1 ♀, TL. 31-35 mm.

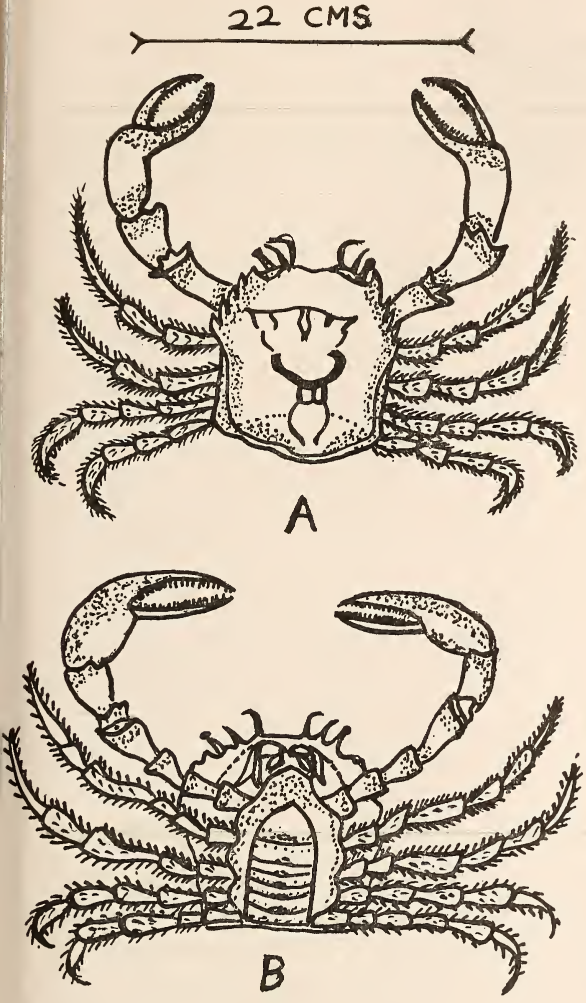

Fig. 6. *Potamon (Acanthotelphusa) woodmasoni* Rathbun.
A. Dorsal side; B. Ventral side.

Diagnostic features:

The cervical groove is deep, broad and superficial. The epigastric crests are rugulose and become indistinct beyond the points where they are met by the cervical groove.

Maximum size 33 mm.

CONCLUSIONS

Previous records show that only *Potamon* (*Acanthotelphusa*) *woodmasoni* Rathbun, *Paratelphusa* (*Barytelphusa*) *harpax* Alcock and *P.* (*Barytelphusa*) *edentula* Alcock were recorded from Assam (Sibsagar Dt.). The present records represent one species of the genus *Potamon* and five species of the genus *Paratelphusa* as the crab fauna of Assam. Out of the six species collected in the present study, *Paratelphusa* (*Barytelphusa*) *guerini* var. *planata* A.M. Edw., *Paratelphusa* (*Paratelphusa*) *sinensis* Edw., and *Paratelphusa* (*Paratelphusa*) *spinigera* Woodmason are new records for Assam. Besides, the distribution range of *Potamon* (*Acanthotelphusa*) *woodmasoni* Rathbun, *Paratelphusa* (*Barytelphusa*) *harpax* Alcock and *Paratelphusa* (*Barytelphusa*) *edentula* Alcock, which were known only from Sibsagar district have been reported from other districts of Assam. (Table 1).

The chelate leg of *Potamon* (*Acanthotelphusa*) *woodmasoni,* Rathbun, has been recorded as bearing 1 sub-terminal spine on the upper border of the merus and 1 strong spine at the inner angle of the carpus. In the present study 3 blunt and 1 pointed spines just above the merus-carpus joint were recorded.

In *Paratelphusa* (*Paratelphusa*) *sinensis* Edw., the presence of a sub-terminal spine on the upper border of the merus and a spine at the inner angle of the carpus of the chelate leg were known, but in the present record, it has been found that a pointed spine with tubercles and a blunt spine at the morus-carpus joint are only present.

In the chelate leg of *Paratelphusa* (*Paratelphusa*) *spinigera* Woodmason, only 1 distinct and acute spine on the merus was reported, but in the present collection specimens with the 4-edges of the merus serrated and provided

TABLE 1

DISTRIBUTION OF THE DECAPOD CRUSTACEANS STUDIED BELONGING TO THE GENERA *Potamon* AND *Paratelphusa* IN ASSAM

District	Goalpara	Kamrup	Darrang	Nowgong	Karbi-Anglong	Cachar	Sibsagar	Lakhimpur	Dibrugarh
Species									
Paratelphusa (*Barytelphusa*) *edentula* Alcock	+	+	—	—	—	—	+	+	+
Paratelphusa (*Barytelphusa*) *guerini* var. *planata* A.M.-Edw.	—	+	+	—	+	—	—	—	—
Paratelphusa (*Barytelphusa*) *harpax* Alcock	—	—	—	—	—	—	+	+	+
Paratelphusa (*Paratelphusa*) *sinensis* Edw.	—	+	+	—	+	—	—	—	—
Paratelphusa (*Paratelphusa*) *spinigera* Woodmason	+	+	+	+	+	+	+	+	+
Potamon (*Acanthotelphusa*) *woodmasoni* Rathbun	—	+	—	—	—	—	+	—	—

with 3 small and 2 large spines were also present.

In *Paratelphusa* (*Barytelphusa*) *guerini* var. *planata* A. M. Edw. the previous records had one epibranchial tooth on the antero-lateral borders of the carapace, but in the present collection the presence of 2 teeth with 11-12 small tooth-like projections in a serrated manner, was noted.

In *Paratelphusa* (*Barytelphusa*) *harpax* Alcock, the orbital border was known to contain only 1 distal tooth, but in the present collection the occurrence of 3-4 distinct teeth was noted as well as additional serrated structures.

In *Paratelphusa* (*Barytelphusa*) *edentula* Alcock, the antero-lateral borders of the carapace are reported to be well arched, distinct, but hardly crest-like, bluntly and feebly crenulate, but in the present collection the serrations are moderately crenulate, with crest and arched structures.

A KEY TO IDENTIFICATION OF THE SPECIES OF THE GENUS *Paratelphusa* AND *Potamon* STUDIED

The texonomy of the fresh water crabs *Paratelphusa* & *Potamon* have been very confusing due to the great morphological plasticity of this groups showing considerable intra-specific variations over shadowing the genetic affinities between related species. Considering the practical difficulties encountered in the present study, a key is prepared and given below to identify all the collected species of *Paratelphusa* and *Potamon*.

Character	S P E C I E S					
	Paratelphusa (*Barytelphusa*) *edentula* Alcock.	*Paratelphusa* (*Barytelphusa*) *guerini* var. *planata* A.M. Edw.	*Paratelphusa* (*Barytelphusa*) *harpax* Alcock	*Paratelphusa* (*Paratelphusa*) *sinensis* Edw.	*Paratelphusa* (*Paratelphusa*) *spinigera* Woodmason	*Potamon* (*Acanthotelphusa*) *woodmasoni* Rathbun.
Carapace	The carapace is broad and convex.	The carapace is broad, deep and strongly convex.	The carapace is a little more convex, but is not so broad, its length always being slightly more than $\frac{3}{4}$th the greatest breadth.	The carapace is convex, its length is $\frac{3}{4}$th to 4/5th its greatest breadth and the surface is pitted.	The carapace is broad and convex and its length is about 2/3rd its greatest breadth, its depth is about $\frac{1}{2}$ its length.	The carapace is fairly broad, convex with an uneven surface.
Antero-lateral borders of carapace	The antero-lateral borders are well-arched.	It is well-defined and irregularly crenulate the lateral epibranchial tooth.	The antero-lateral borders are less convex.	The antero-lateral borders are sharp and moderately curved, armed with three strong teeth exclusive of the orbital angle.	The well arched antero-lateral borders are sharp and indistinctly crenulate.	The antero-lateral borders of carapace cut into four clow like spines.
Chelipeds	The chelipeds are sub-equal in the female, unequal but not immoderately so in the adult male.	The chelipeds are unequal in the male than they are in the female.	In both male and female the chelipeds are similar in size.	The chelipeds are unequal, very much more so in the male than in the female.	The chelipeds are unequal in both sexes.	In the adult female the chelipeds are almost equal and are rather slender and shorter than the legs.

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SEASONAL CHANGES IN THE HERD STRUCTURE OF BLACKBUCK[1]

N. L. N. S. Prasad[2]

(*With a plate and a text-figure*)

Five herds of blackbuck, constituting a population of over 50 animals, were observed during 1978-80 at Mudmal (16°24′N and 77°27′E) in Andhra Pradesh. The population increased to over 100 animals at the end of the study. There were five categories of social groupings most commonly met with namely: a) Mixed herds consisting of loose aggregations of males and females of various age groups; b) Herds consisting of only males — the bachelor herds; c) Herds formed solely of females; d) A single male territorial in nature accompanying several females; e) Lone territorial males.

The minimum and maximum herd size observed was 2 and 36 respectively. The mean herd size was 11.05 (SD 6.22). There were seasonal fluctuations in the mean herd size. During monsoon and winter seasons larger herds were more common compared with summer season. The size of five social groupings also registered a considerable change seasonally. The factors contributing to the changes in the herd structure are discussed.

INTRODUCTION

The present paper is based on a long term study carried out on blackbuck at Mudmal and describes the trends in the herd structure and the factors influencing it.

STUDY AREA AND METHODS

Mudmal village and its surroundings are located between 16°22′-16°26′N and 77°25′-77°27′E in Andhra Pradesh. The total study area was approximately 80 km². Over 80% of the area was cultivated and the rest of the area included patches of grasslands, rocky elevations, tanks, and phoenix groves. Other details of the study area were described elsewhere (see Prasad & Ramana Rao 1984).

Free populations of over 50 blackbuck, distributed in five separate herds, were located in the area and were followed for a period of nearly two years. At the end of the study the total population increased to over 100 animals. All observations were made on foot with the help of 8 x 40 binoculars. Each time a herd was sighted, the number of individuals in the herd, composition of sex and age classes such as adult male, sub-adult male, adolescent male, adult female, sub-adult female and fawn were recorded. When an adult male was sighted the details such as the intensity of black colour on the coat, the shape of horns, whether territorial or otherwise were noted. Based on this data 11 males were individually identified during the course of the study. Females however, could not be identified individually.

In the case of males, the age classes were

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distinguished by the horn structure. Males with horns having less than two twists were classified as adolescents, horns with 2-3 twists and more than 3 twists were considered as sub-adults and adults respectively (see Mungall 1978). A twist is a curve to the outside (Cary 1976). In the case of females, the body size and coat colour were taken as criteria to differentiate between the age classes.

During periods of continuous observations which lasted between 1-10h, the number of animals that joined and left the herd under observation were noted. When part of the herd split up and moved far so that observations could not be made on those animals, the number of animals that remained in the area was considered for the purpose of calculating the change in the herd size. Besides, the changes in the vegetation, activity patterns of blackbuck in relation to vegetation, the disturbance by cultivators, shepherds, carts, and other vehicles and the response of blackbuck observed were noted.

RESULTS

The composition of the five herds most frequently met with during September-December 1979 is shown in table 1. Changes in the herd structure however occurred in different seasons. The social organization of these herds was basically of five types:

a) Herds formed by males and females of all age groups which are generally known as mixed herds
b) A single territorial male with a group of females, termed pseudoharem (Mungall 1978)
c) Herds formed by males — the bachelor herds
d) Herds consisting solely of females
e) Lone territorial males

Apart from these categories, lone females were also sighted particularly either when they were pregnant or when they had recently given birth to fawns.

Over 1400 sightings of herds revealed a mean herd size of 11.05 (SD 6.22) with minimum and maximum being 2 and 36 respectively. The mean herd size varied with seasons (Tables 2 & 3). It increased from summer to winter through monsoon. There was an increase in the mean herd size from summer of 1978-79 to summer of 1979-80 which could probably due to increase in the population of the herds by the birth of fawns.

The frequency distribution of herd size classes for the three seasons is shown in the

TABLE 1

THE COMPOSITION OF FIVE HERDS MOST FREQUENTLY OBSERVED DURING SEPTEMBER-DECEMBER 1979

Herd	Territ. Male	Adult Male	Sub-adult Male	Adolescent Male	Adult Female	Sub-adult Female	Fawn	Total
A	1	2	1	—	7	2	2	15
B	1	2	2	5	10	5	1	26
C	1	2	1	3	12	2	2	23
D	1	2	1	—	11	—	1	16
E	1	1	—	2	9	—	2	15
Total	5	9	5	10	49	9	8	95

TABLE 2

MEAN HERD SIZE DURING 1978-1979

Season	Mean herd size	S.D.	Coeff. of variation	Total
Summer	6.82	3.77	55.24	71
Monsoon	11.35	6.40	56.39	264
Winter	12.29	7.29	59.37	177

TABLE 3

MEAN HERD SIZE DURING 1979-1980

Season	Mean herd size	S.D.	Coeff. of variation	Total
Summer	10.51	6.13	58.30	232
Monsoon	11.64	6.21	53.37	466
Winter	13.66	7.04	51.53	196

TABLE 4

DISTRIBUTION OF HERD SIZE CLASSES DURING 1978-79

	Herd size classes						
Season	1	2-7	8-13	14-19	20-25	≥ 26	Total
Summer	3	43	19	5	1	0	71
Monsoon	5	65	101	51	29	13	264
Winter	5	43	61	35	24	9	177
Total	13	151	181	91	54	22	512

TABLE 5

DISTRIBUTION OF HERD SIZE CLASSES DURING 1979-80

	Herd size classes						
Season	1	2-7	8-13	14-19	20-25	≥ 26	Total
Summer	14	62	91	53	10	2	232
Monsoon	25	96	164	128	46	7	466
Winter	10	39	49	52	38	8	196
Totals	49	197	304	233	94	17	894

tables 4 and 5 for the years 1978-79 and 1979-80 respectively. An anova test was conducted with the null hypothesis that the frequency of herd size is independent of seasons and that there is no appreciable difference in the frequency of herd size classes in a given season. This hypothesis was rejected at 5% level of significance for the three seasons (Tables 6 and 7).

From tables 4 and 5 it is clear that the herd size classes 8-13 followed by 2-7 were more frequently seen than the rest in all seasons. There were, however, seasonal differences in the proportion of sightings of the various herd size classes. During summer season the proportion of herd size classes 2-7 and 8-13 were higher. It is also explicit that compared with monsoon and winter seasons, during summer season herd size of 14-19 and the classes below it were more frequent while during winter and more so during monsoon herd sizes larger than

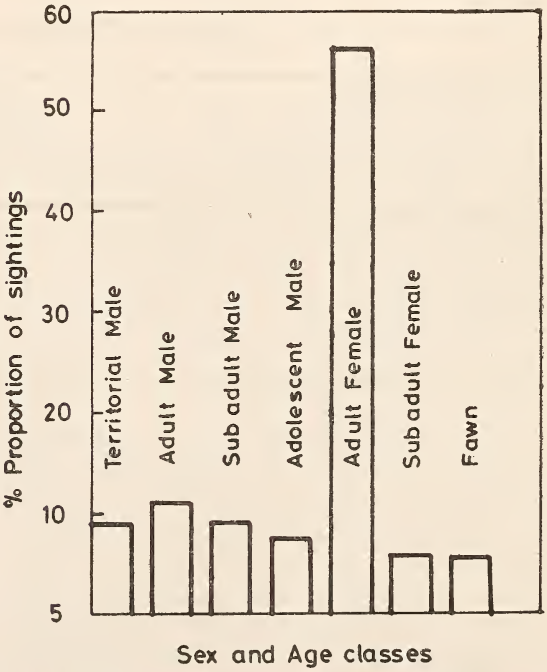


Fig. 1. % Proportion of various sex and age classes.

TABLE 6

TWO WAY ANALYSIS OF VARIANCE OF HERD SIZE CLASSES IN THREE SEASONS DURING 1978-79

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance Ratio (F)	Tabulated F value at 5%
Between seasons	3114.11	2	1557.06	7.08	4.10
Between herd size classes	7907.11	5	1581.42	7.19	3.33
Residual	2199.22	10	219.92	—	—
Total	13220.44	17	—	—	—

TABLE 7

TWO WAY ANALYSIS OF VARIANCE OF HERD SIZE CLASSES IN THREE SEASONS DURING 1979-80.

Source of variation	Sum of squares	Degrees of freedom	Mean square	Variance Ratio (F)	Tabulated F value at 5%
Between seasons	164	2	3582.0	6.06	4.10
Between herd size classes	21278	5	4255.6	7.20	3.33
Residual	5910	10	591.0	—	—
Total	27352	17	—	—	—

TABLE 8

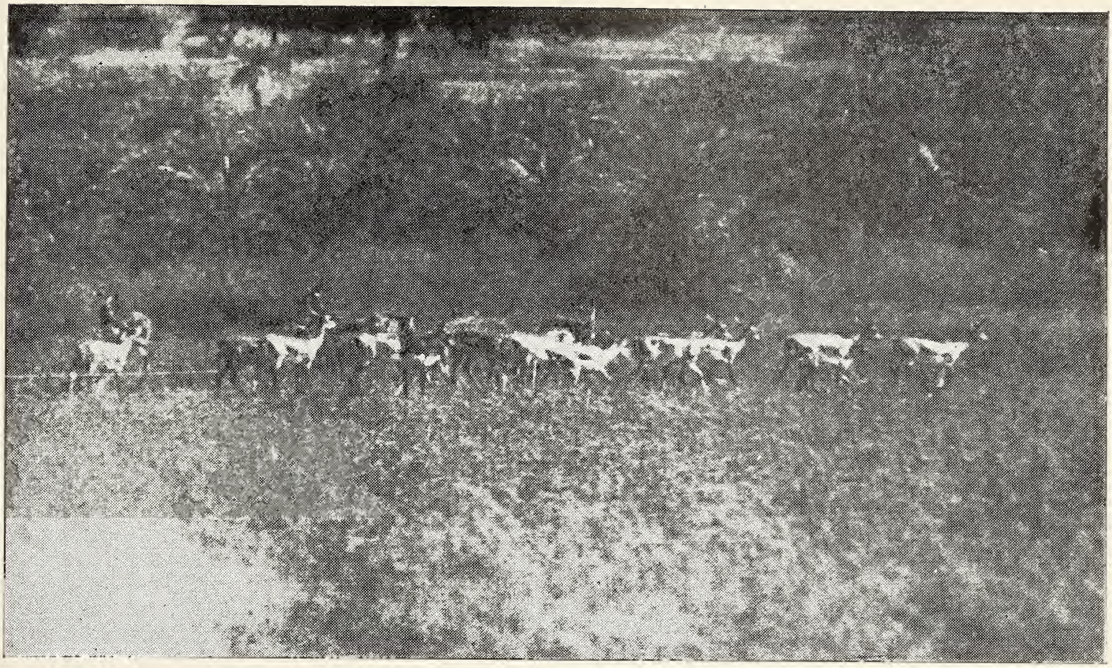
% PROPORTION OF SOCIAL GROUPINGS IN VARIOUS SEASONS DURING 1978-1980

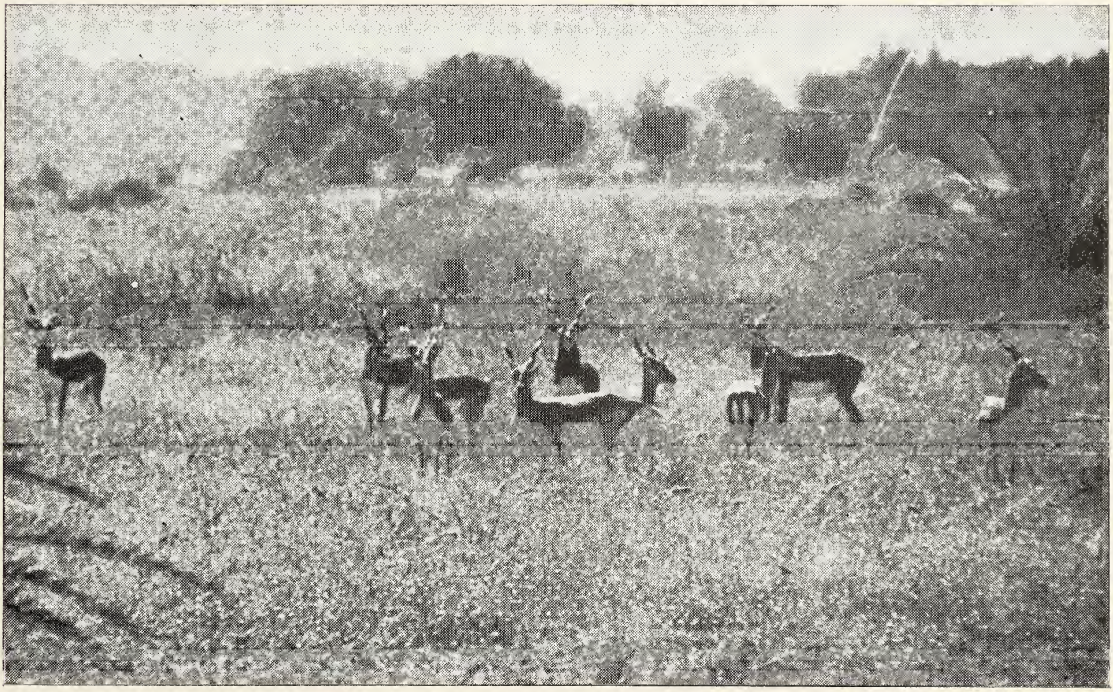
Season	Mixed herds	Pseudo-harems	All female	Single males	Bachelors	Total
Summer	69.30	17.16	6.27	5.61	1.65	303
Monsoon	73.42	14.38	5.62	4.11	2.47	730
Winter	75.34	10.19	4.83	4.02	5.63	373

14 were more frequently met with as compared with summer.

The distribution of proportion of the sex and age classes of the herds is shown in fig. 1. Adult females constituted the highest with 57.24% followed by the adult males with 11.29%. The sub-adult males (9.08%) and the territorial males (8.73%) were represented next. The rest of the classes formed only 13.66%. These sightings showed an adult male to adult female ratio of 1:2.47 and one fawn to every 8.76 adult females.

The seasonal changes in the social groupings of blackbuck is shown in the table 8. The mixed herds were more frequent in all seasons and ranged between 69-75%. Pseudo-harems with 10-17% were next common social groupings. The mixed herds were compara-





Above: Congregation of the members of herd B after a drive by cultivators.
Below: A bachelor herd.

(*Photos*: N. L. N. S. Prasad)

tively less in summer season than in other seasons while the pseudo-harems were more frequent in summer compared with the rest of the seasons.

Out of 195 sightings of pseudo-harems, 5% constituted a lone territorial male with a single adult female. The maximum size of the pseudo-harems was 26 (1 territorial male with 25 females). A total of 64 sightings on single animals contained 70.3% territorial males, 18.7% females, and 11% adult and sub-adult males.

The bachelor groupings were sighted 44 times. 75% of these had 3-7 males. 18.2% of these sightings showed only two males together. The maximum size of the bachelor herd was 9 which was sighted 6.8% times.

Discussion

A tendency exists among animals to band together in flocks, herds, schools, or loose colonies. In all social systems in general, two opposing forces operate simutaneously: mutual attraction versus social intolerance to establish social dominance, the former contributing to herding while the latter against crowding (Smith 1980). The combination of terrain and vegetation profile have a pronounced effect upon herd size and composition among blackbuck (Mungall *et al.* 1981), Now, the question what contributes to the changes in the herd structure finds three possible answers here. The first one is forage based, the second based on the social aspects, and the last the disturbance by cultivators. A small herd will do well with less competition for forage while a large herd will have a heavy competition amongst the members of the herd and at the same time would deplete the resources in the area by overgrazing. This could be the reason for the maximum sightings in the category of 8-13 herd size class in all seasons. The larger proportion of smaller size herds during summer (Tables 4 & 5) also confirms this. During summer as food becomes very scarce, the herds would further split up into small herds and would move about in search of fresh grass. The occasional presence of larger herds during summer, however, is explained by the fact that blackbuck concentrate on groundnut fields and near wells where sprouting of grasses occurs due to continuous watering of the fields.

The occurrence of larger herd size in greater proportion during monsoon was because of availability of large quantity of fresh forage on grasslands. During winter blackbuck would concentrate in jowar cultivated fields where some palatable grasses were still present. At the time of appearance of the earhead till the harvest of jowar crop, the concentration of blackbuck in these fields was a common sight.

Splitting of herds resulted when the herds were subjected to heavy stress, particularly by cultivators who chase blackbuck when they locate them near their fields. This driving also would result in a small group joining another in an adjacent area thus forming a larger herd. This was a common sight at all seasons.

Turning to the changes in the herd composition seasonally, it is clear that mixed herds were the most common. A large proportion of the pseudo-harems were observed during summer season compared with other seasons. This could not, however, be assigned to the peak of breeding activity as summer was just the starting time of establishment of territory by the territorial males, and hence this point is difficult to explain. The increase in the bachelor herds from summer to winter through monsoon, however, resulted mostly due to driving of bachelor males by the territorial males from their territories to have more access to the females.

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THE FORMER DISTRIBUTION OF THE INDIAN RHINOCEROS (*RHINOCEROS UNICORNIS*) IN INDIA AND PAKISTAN[1]

L. C. ROOKMAAKER[2]

The existence of the rhinoceros in prehistoric times is known from different sites in the Indus valley of Pakistan, and in the Indian states of Rajasthan, Gujarat, Uttar Pradesh, Bihar and possibly Karnataka. There are written and pictorial records testifying to the occurrence of the animal in those regions of India and Pakistan at least until the 16th century. The species concerned is the Indian rhinoceros, *Rhinoceros unicornis* Linnaeus, 1758.

INTRODUCTION

Three recent species of rhinoceros are known to have occurred in parts of the Indian subcontinent. The double-horned Sumatran rhinoceros (*Dicerorhinus sumatrensis*) was reported from Assam and some regions bordering on Burma before 1880. The Javan rhinoceros (*Rhinoceros sondaicus*) was known definitively from the Sunderbans area of Bangladesh and has been said to exist as far north-west as Assam and Sikkim. The Indian rhinoceros (*Rhinoceros unicornis*) has been recorded in Assam, Nasirabad, Sylhet and Cachar (Rookmaaker 1980). It is still present in various reserves in N. E. India and in Nepal. The rhinoceros also once inhabited other parts of India and Pakistan, as described by Shebbeare (1953: 142): "[it] inhabited the sub-Himalayan tract during prehistoric times, the western limits of its range retreating from Peshawar, in the days of Babur (1505-1530), to Rohilkhand (the Barelli district) in the mid-19th century and the Nepal terai during the present century." The distribution of the rhinoceros in Pakistan and India outside the N.E. provinces until the 16th century and its retreat — the last record as far west as the Philibit district near the Nepal border dated from 1876 — has been reviewed or mapped by Lydekker (1907: 30), Guggisberg (1966: 135), Seshadri (1969: 92) and Mukherjee (1963: 45-47, 1974:339-341). Usually, these records have been assumed to pertain to *R. unicornis*, but the animals rarely have been identified as *R. sondaicus*. Recently, there have been proposals to translocate Indian rhinoceroses from Assam to other areas within their former range. The first pair to be translocated arrived in the Lal Sohanra National Park in Pakistan on 23 March 1982 (Nawaz 1982), while other animals are supposed to be sent to Dudwa National Park in U.P. soon (Baidya 1982).

In view of these plans, it is evidently important to establish the former limits of the range of the rhinoceros as accurately as possible. In this paper I shall review all available data concerning the distribution of the rhinoceros in Pakistan and India (west of Assam). These will be divided in the information on the fossil specimens found in this region, and the literary and iconographic sources dating

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from the 14th to the 17th century. The specific identity of this rhinoceros will also be discussed. Many sources have been quoted extensively, because many are only available with great difficulty to zoologists and because it is useful to compare them all in one place.

PREHISTORIC RECORDS

Rhinoceros remains have been discovered in prehistoric sites in several Indian states. Pictorial representations possibly dating from the same period add localities in Pakistan and in Bihar. Few of the fragmentary remains have been described in detail and their identification as *R. unicornis* often has been taken for granted. Guérin (1980) presented extensive descriptions with measurements of the post-cranial skeletons of the five living species of rhinoceros. He observed that specific differences, either qualitative or quantitative, could be found in almost all bones. More specifically. *R. sondaicus* resembled *R. unicornis* osteologically, but they could be distinguished by size, proportions and other qualitative criteria (Guérin 1980: 74). It may be insufficient to compare specimens on paper only, and hazardous to presuppose the same size in prehistoric and recent specimens of the rhinoceros. Nevertheless, I shall compare the published descriptions of the fossil bones found in India with the analyses by Guérin (1980). The locations and ages of the different sites were taken from the publications describing the rhinoceros fragments.

PAKISTAN

Harappa

(Sihawal district on Ravi river; 2500-1500 B.C.)

Prashad (1936: 31) described a fragment of a right scapula. The stated measurements (length *c.* 470 mm, maximum width *c.* 250 mm) are larger than those of *R. sondaicus* (Guérin 1980: 77). This points at *R. unicornis* (Prashad 1936, Roberts 1977: 159, Nath 1968: 18).

Mohenjo Daro

(Indus valley; *c.* 3000 B.C.)

Several seals and pottery objects representing a rhinoceros were found in Mohenjo Daro (Marshall 1931, I: 72, 205, 348, 353, II: 387). The animal is sometimes depicted "standing over a manger-like object" possibly indicating its keeping in captivity (Marshall 1931, I: 348), while to Conrad (1968: 253) this suggested worship of the rhinoceros. Marshall (1931, I: 348) thought that the species must have been well-known to the people judging "from the frequency with which it is represented, and it was, therefore, likely to have been found in the close vicinity of Mohenjo Daro." Brentjes (1978: 159) identified the animals on the seals as *R. unicornis.*

INDIA

RAJASTHAN

Kalibangan

(Ganganagar district; 3500-400 B.C.)

Banerjee & Chakraborty (1973) reported the discovery in 1965 of four bone fragments referred to *R. unicornis*: a left tibia (distal diameter 125 mm), a right humerus (distal diameter 126 mm), a first phalanx of the 4th metatarsal, and a 3rd metatarsal of the right foot (length 190 mm). In all cases, the measurements are larger than those of living *R. sondaicus* and compare better with those of *R. unicornis* (Guérin 1980: 126, 79, 147; see Nath 1969: 107).

GUJARAT

Langhnaj

(23° 47′N, 72° 25′E; pre-pottery phase)

Zeuner (1952:130-131) gave details about a left scapula (length 430 mm) which showed traces possibly indicating its use as an anvil by a microlith-maker. To Zeuner, "its characters agree with the species *Rhinoceros unicornis,* though the teeth found at Langhnaj suggest the possibility that a sub-species occurred in Gujarat which is not identical with the surviving Nepal and Bengal races." There is no evidence substantiating this suggestion (*see* Sankalia & Karve 1949).

Clutton-Brock (1965: 9-10) mentioned more remains from Langhnaj: a left scapula (width of the neck 128, 6 mm), a right humerus, a talus, and a fragment of a molar tooth. The scapula and talus were referred to *R. unicornis,* while the other fragments were too damaged to allow proper identification.

Kaneval

(20 km N.W. of Cambay or Khambat; 8000-1200 B.C.)

Momin *et al.* (1973) reported some rhinoceros fragments found in different sites around Lake Kaneval: 3 (partial) cervical vertebrae and the proximal end of a tibia. The vertebrae are illustrated (Momin *et al.* 1973: figs. 2, 3), but these bones do not present specific characteristics (Guérin 1980: 74). Momin *et al.* (1973: fig. 1) figured the tibia, without description although suggesting its use as an anvil.

SIWALIK HILLS

During the last century, fossilized rhinoceros remains were found in several deposits in the Siwalik hills and others of similar age (ranging from miocene to lower pleistocene). They were assigned to several (new) taxa:

- *Rhinoceros indicus* [=*unicornis*] *fossilis* Baker & Durand, 1836: 493;
- *Rhinoceros platyrhinus* Falconer & Cautley, 1847, pls. 73-75;
- *Rhinoceros palaeindicus* Falconer & Cautley, 1847, pls. 73-75;
- *Rhinoceros sivalensis* Falconer & Cautley, 1847, pls. 73-75;
- *Rhinoceros perimensis* Falconer & Cautley, 1847, pls. 73-75;
- *Rhinoceros namadicus* Falconer, 1868, I: 157ff., 513;
- *Rhinoceros namadicus* Lydekker, 1876 (not of Falconer).

Many of these forms were described in detail by Lydekker (1881, 1884: 82-83, 1885: 61-65, 1886), who synonymized his own *R. namadicus* from the Nerbudda valley with *R. unicornis* in 1886. The relation of these taxa to the recent species of *Rhinoceros* and to each other, whether (near-) identical or not, whether ancestral or not, has to my knowledge not been clarified sufficiently. Heissig (1972) recently described some ancient fragments from the lower and middle Siwalik-deposits as *Rhinoceros* (*Rhinoceros*) aff. *sivalensis, R.* (*Gaindatherium*) *browni, R.* (*G.*) *vidali, Didermocerus* aff. *sumatrensis* (one P^2) and *Eurhinoceros sondaicus* (one P^1 and one P^2). Guérin (1980: 168, 170) questioned the last two identifications as the material was very old and very limited.

As a neontologist and taxonomist, I was surprised at Heissig's use of *Eurhinoceros* as a full genus with the species *sondaicus. R. unicornis* is said to be the type-species of *Rhinoceros* Linnaeus, 1758 and *R. sondaicus* that of *Eurhinoceros* Gray, 1867 [=1868]. Gray (1868) divided the genus *Rhinoceros* into two subgenera: typical *Rhinoceros* with *R. stenocephalus,* and *Eurhinoceros* with *R. javanicus* [=*sondaicus*], *R. unicornis, R. nasalis* and *R. floweri.* This too is a rather curious classification which, however, does not concern us at present. It would seem that Heissig's interpretation of *Eurhinoceros* would need further clarification.

UTTAR PRADESH

Mirzapur petroglyph

A rock drawing in the "Ghormangur rock-shelter near the fortress of Bidyergurh in the Mirzapur district" is described and illustrated by Cockburn (1883). It shows a single-horned rhinoceros surrounded by hunters, but its identity is not clear (Bhaduri *et al.* 1972: 404, Rookmaaker 1980: 258).

Banda

Cockburn (1883) found some fragmentary rhinoceros bones "in the ravines of the Ken river, 2 miles due south of the town of Banda" which he tentatively assigned to *R. unicornis.*

BIHAR

Chirand

(Saran district; *c.* 1700 B.C., neolithic)

Nath (1976) reported 4 fragments: a left humerus, upper molar tooth, left tibia and ulna. The bones are not described, but referred to *R. unicornis.*

MADHYA PRADESH

No material has been discovered in this state. Sagreiya (1969: 718) concluded that if the rhinoceros ever "did occur in parts of Madhya Pradesh, [it] disappeared before the Aryans arrived."

SOUTH INDIA

Lydekker (1880) described a single M^3 from the alluvium of Madras as *R. unicornis* (see Hooijer 1946: 84). Another specimen found 3½ miles N. E. of Gokak, Belgaum district (Karnataka) was described as *Rhinoceros deccanensis* by Foote (1874). It appears premature to state on the basis of this meagre evidence, that *R. unicornis* used to occur in this part of India, which would allow future re-introduction (Krishne Gowda 1975-309).

HISTORICAL RECORDS

Several medieval Muslim authors wrote about encounters with the rhinoceros in Pakistan or India (Ettinghausen 1950). The majority seems to be based on second-hand information, but those by al-Beruni and Ibn Battuta deserve further consideration. Several Indian authors of the 16th and 17th century claimed to have observed these animals. This evidence was partly reviewed by Yule & Burnell (1903: 363, 762), Ali (1927) and Rao (1957: 269).

al-Beruni, one of the Muslim authors who wrote a book about India (*c.* 1030), gave the following details:

> "The ganda exists in large numbers in India, more particularly about the Ganges. It is of the build of a buffalo, has a black scaly skin, and dewlaps hanging down under the chin. It has three yellow hoofs on each foot, the biggest one forward, the others on both sides. The tail is not long, the eyes lie low, further down the cheek than is the case with all other animals. On the top of the nose there is a single horn which is bent upwards. The Brahmins have the privilege of eating the flesh of the ganda. I have myself witnessed how an elephant coming across a young ganda was attacked by it.

The ganda wounded with its horn a forefoot of the elephant, and threw it down on its face" (Sachau 1910: 203-204).

The author continued about his uncertainty whether the ganda was in fact the rhinoceros.

Ibn Battuta, an Arab traveller, saw rhinoceroses near the Indus river in 1334 as follows:

> "After crossing the river of Sind called Banj Ab, we entered a forest of reeds, following the tracks which led through the midst of it, when we were confronted by a rhinoceros. In appearance it is a black animal with a huge body and a disproportionately large head. For this reason it has become the subject of a proverb, as the saying goes Al-karkaddan ras bila badan (rhinoceros, head and no torso). It is smaller than an elephant, but its head is many times larger than an elephant's. It has a single horn between its eyes, about three cubits in length and about a span in breadth. When it came out against us one of the horsemen got in its way; it struck the horse which he was riding with its horn, pierced his thigh and knocked him down, then went back into the thicket and we could not get at it. I saw a rhinoceros a second time on this road after the hour of afternoon prayer. It was feeding on plants but when we approached it, it ran away. I saw a rhinoceros yet another time when in the company of the king of India we had entered a jungle of reeds. The sultan was mounted on an elephant and we too were mounted on elephants along with him. The foot-soldiers and horsemen went in and beat it up, killed it and conveyed its head to the camp" (Gibb 1971: 596).

Babur, the Moghul emperor reigning from 1505 to 1530, hunted the rhinoceros several times. His accounts are quite extensive and unfortunately too long to reproduce in full. In February 1519 he wrote:

> "I went to hunt rhinoceros on the Sawati side [Suabi, west of the Indus river] which place people call also Karg-khana (Rhino-home). A few were discovered but the jungle was dense and they did not come out of it" (Beveridge 1970: 378).

One calf came out and escaped, another died when the jungle was set on fire. In December 1526, Babur had another encounter with the animal:

> "There was a rhino in a bit of jungle near Bigram [Peshawar]. ... It took its way across the plain. Humayun and those come with him from that side (Tramontana), who had never seen one before, were much entertained. It was pursued for two miles; many arrows were shot at it; it was brought down without having made a good set at man or horse. Two others were killed" (Beveridge 1970: 451).

When it came face to face with an elephant, it did not attack but turned in another direction. A few years later, in March 1529, near Benares no rhinoceros was discovered (Beveridge 1970: 657). Babur gave a comprehensive description of the rhinoceros in his list of the animals of Hindustan:

> "This also is a large animal, equal in bulk to perhaps three buffaloes. ... It has a single horn on its nose more than 9 inches (qarisch) long; one of two qarisch is not seen..... The rhinoceros' hide is very thick; an arrow shot from a stiff bow, drawn with full strength right up to the arm-pit, if it pierces at all, might penetrate 4 inches (ailik, hands). From the sides (qash) of its fore and hind legs, folds hang which from a distance look like housings thrown upon it. ... There are masses of it in the Parashawar and Hashnagar jungles, so too between the Sind river

> and the jungles of the Bhira country. Masses there are also on the banks of the Saru river in Hindustan" (Beveridge 1970: 489-490).

Sidi Ali, a Turkish admiral of Suleiman the Great, saw rhinoceroses in northern Pakistan in 1556 (Yule & Burnell 1903: 762). The passage is here translated from the French published by Moris (1826: 201-202):

> "We left the city of Pourschewer [Peshawar], and having happily passed the Koutel [Kotak], we came to the city of Djouschayeh. At the Koutel, we saw rhinoceroses approaching in size the elephant. Those rhinoceroses had a horn of two hands length on the forehead; but it is a fact that those living in Abyssinia have longer horns."

Akbar, the 3rd Moghul emperor (1542-1605), had his memoirs written about 1590. The rhinoceros was found in the "Sarkar of Sambal", near Sambhal in Utter Pradesh (Jarratt 1949, II: 285). It is described as follows:

> "The rhinoceros is a stupendous creature. He is twice the size of a buffalo and much resembles a horse in armour. His feet and hoofs are like those of an elephant, and his tail similar to a buffalo's, and he has a pastern-joint like a horse. On the point of his snout he carries a single horn and his hide is so thick that an arrow will not pierce it. Of this, breast-plates and shields and the like are made, and he is bold enough to charge a man on horse back" (Jarrett 1949, III: 134).

Jehangir, another Moghul emperor who wrote his memoirs. In the passage given here translated by Beveridge, "wolf" is given instead of "rhinoceros" because the latter was unlikely to live in the region mentioned. This is questioned by Ali (1927: 861) and Kühnel (1941).

> "One day I was on an elephant, and was hunting wolves in Aligarh in the Nuh forest. A wolf appeared, and I struck it with a bullet on its face (mana) near the lobe of the ear. The bullet penetrated for about a span. From that bullet it fell and gave up its life. It has often happened in my presence that powerful (jawanan) men, good shots with the bow, have shot twenty or thirty arrows at them, and not killed" (Beveridge 1968, II: 270).

A Portuguese embassy to Muzafar II, King of Cambaia, was presented with a living rhinoceros in May 1514. Its place of capture is not recorded. It had been kept in Champanel and was transported to Lisbon *via* Goa by the Portuguese. It lived in Lisbon from 20 May 1515 until December 1515, when it was sent to Pope Leo X in Rome. It drowned on its way at the Italian coast near Porto Venere in February 1516 (Da Costa 1937, Rookmaaker 1973: 39-40).

ICONOGRAPHY

There are rather a large number of miniatures and other representations depicting "naturalistic" rhinoceroses made in India between 1500 and 1650. Some have recently been figured, e.g. by Ettinghausen (1950: pls. 21, 30, 32, 33), Brentjes (1969), Lewis *et al.* (1966: pl. 23) and Kühnel (1941: fig. 2). These animals are undeniably rhinoceroses, but few would appear to allow further identification. One such miniature may be mentioned especially. It shows Jehangir hunting rhinoceroses and it is dated *c.* 1600 (kept in O. Sohn-Rethel collection, Düsseldorf — reproduced by Kühnel 1941, Ettinghausen 1950: pl. 33 and Brentjes 1969). The identity of this animal is discussed below.

DISCUSSION

The records of rhinoceroses in India and Nepal were generally attributed to the Indian rhinoceros (*R. unicornis*). Blyth (1872: 3107), however, considered that the length of the horn and the possibility to penetrate the hide with arrows mentioned by Babur appeared "tolerably sufficient" to indicate *R. sondaicus* rather than *R. unicornis.* Brentjes (1969) identified an animal in one of the miniatures showing Jehangir's hunt as *R. sondaicus inermis.* The animals in this figure look enough like a single-horned rhinoceros that the appearance of the animal must have been known. These representations, however, were not intended to show characteristics which would allow us to separate the two species of *Rhinoceros.* The miniature discussed by Brentjes probably is one of the few which shows the folds naturalistically, at least at first sight. I believe that this is accidental. There are important differences between the two specimens in the picture and some folds (anterior shoulder fold and scapular fold) are missing entirely.

All evidence presented above suggests that it was indeed *R. unicornis* which inhabited the northern part of the Indian peninsula until relatively recently. In prehistoric times, this species occurred in parts of Pakistan (Indus valley) and India (Rajasthan, Gujarat, Uttar Pradesh and Bihar). In the 16th century the animal was still rather common in appropriate habitats in N.W. India. There is no reason to suspect that the Moghul emperors hunted captive or imported specimens. There are no records at all for the 17th and 18th centuries. The rhinoceroses must have disappeared from many areas during that period. In the 19th century it was occasionally reported from eastern Uttar Pradesh and Bihar, and it must have been quite rare then.

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SOME NOTES ON THE ECOLOGY AND STATUS OF THE ORANGERUMPED HONEYGUIDE *INDICATOR XANTHONOTUS* IN THE HIMALAYAS[1]

S. A. HUSSAIN AND SALIM ALI[2]

(*With a plate*)

INTRODUCTION

The family Indicatoridae comprising of four genera[3] (*Indicator, Melichneutes, Melignomon* and *Prodotiscus*) and 11 species occurs in Africa, India, Burma and Malay archipelago. Of these, four species of three genera are exclusive to Africa and a single genus is represented by five species in Africa and one each in the Indian subcontinent and Malay archipelago. Of the total 11 species, five are known to be brood parasites of other species of birds, while two are suspected to be so in Africa. Another peculiarity of the family is the symbiotic relationship of some species with other animals, and their habit of 'guiding' man to bee hives in Africa.

In a comprehensive monograph based on earlier literature, personal observations, and an analysis of the data collected through various sources Friedmann (1955) has discussed the biological considerations of the family Indicatoridae. His study was mainly prompted by two aspects of behaviour, namely Symbiosis and Brood-parasitism. Since these aspects of behaviour are related to much wider and complicated biological and evolutionary factors it was imperative that all other aspects relating to the complete life history of the family be covered in order to gain a proper insight into this very interesting and unique family of birds. Friedmann's monograph covers almost all aspects of the biology, zoogeography and ecology of the family and provides an excellent comprehensive base line of information on the current status of the family. However, the monograph, as conceded by the author, is by no means complete. Information about several species is either meagre or virtually non existent. Very little is known of the Himalayan Orangerumped Honeyguide. Our information about this bird has been based mainly on some stray notes published by early naturalists and casual observations by later ornithologists during their surveys.

BACKGROUND

In 1973 Sálim Ali while surveying the avifauna of the eastern Himalayas, discovered about 20-25 honeyguides feeding on a cluster of honey combs in central Bhutan. Considering the observation potential and accessibility of the area, a trip during the putative breeding season (April-May) was proposed to obtain some data on the breeding biology and other behaviour of the bird. The field trip, initiated by the Bombay Natural History Society and financed from the Sálim Ali Nature Conservation Fund (SANCF), was planned for summer 1977. One of us (SAH) spent about a month-and-a-half from mid May to end

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[1] Accepted August 1983.

[2] Bombay Natural History Society, Horbill House, Shaheed Bhagat Singh Road, Bombay-400 023.

[3] There has been some difference of opinion about the number of genera and species. Friedmann (1974), now recognises 17 species.

June and again during October the same year we visited Central and Western Bhutan to study the honeyguide and survey the area. This paper is based on the information gathered during the study period as well as on correlated data from earlier literature and our own notes from other parts of the Himalayas. An attempt is made to substantiate our knowledge of some aspects of behaviour and ecology of this species. Considering the limited scope and potential of the present study, this paper is intended merely as a preliminary assessment for a long term investigation which may be undertaken in future.

PAST LITERATURE

The Orangerumped Honeyguide *Indicator xanthonotus* was first described by Blyth in 1842 from a specimen obtained at Darjeeling. Two sub-species have been described in the subcontinent, apart from the nominate race. Hume's *radcliffi*, was described by him based on a single specimen collected from Hazara district in north-west Himalayas, and its validity has been questioned by later ornithologists (Ali and Ripley 1970) due to the lack of supporting material. Ripley (1951) separated the easternmost population as *fulvus* based on two specimens collected by him from Naga Hills. Apart from these there are only occasional notes published in various journals (Hume 1873, Stoliczka 1873, Magrath 1909, Smythies 1949).

No information about eggs, nestlings and fledglings or authentic records of feeding, mating, calls and other behaviour is available. In 1973 we collected eight specimens (3♂♂ and 5♀♀) from central Bhutan on 31st October, and recorded as follows: "A sandstone cliff face *c.* 80 ft. high, c. 100 ft. square, sheer above road, almost overhanging it, with *c.* 15-20 large active combs of *Apis dorsata* at different levels, some very close to one another others more spaced. On approach to spot, on turning a bend, 2 sparrow-like birds flew up from a dry gutter along base of cliff and crossed the path of our jeep showing orange rump. Examination of cliff revealed 27 *I. xanthonotus,* some chasing one another across the cliff face — reminiscent of Baya rivals at nest colony". Recently Cronin and Sherman (1977) have reported on an excellent study carried out by them "over several seasons" in eastern Nepal.

TAXONOMICAL NOTES

The Orangerumped Honeyguide is of the size of a sparrow and has perhaps the most striking colour pattern of all the species of honeyguides. Another distinguishing feature is the bill which is small, stout and finchlike.

Description:

Forehead and lores orange. Upper plumage dark grey washed with a tinge of olive on mantle and nape. The dark grey feathers of the primaries and secondaries have pale olive margins giving an overall streaked effect on the dorsal side. Deep orange of the rump extends up to upper back where it is almost sulphur yellow. Primaries and tail feathers dark grey. Chin and throat washed with yellow. Lower plumage pale grey marked with dark grey streaks.

Female: The yellow of the forehead, chin and throat less extensive Rump more yellow than orange, turning into sulphur yellow to almost iridescent white on the upper back. Rest like the male.

Subspecific notes:

Hume's 'species' *radcliffi* was based on a specimen collected from Hazara in the extreme northwest Himalayas. The validity of this race has not been fully confirmed due to lack of more specimens. Ali & Ripley (1970) mention Hugh Whistler seeing this bird on 24th April 1923 at Trinn, Dharmasala, *c.* 2900 m and consider it as the last authentic record. However, Friedmann (1974) mentioned Walter Koelz's collection in 1940's as containing several specimens of Honeyguides from Garhwal (exact locality not specified). The nominate *xanthonotus* extends eastwards of the range of *radcliffi* along Himalayas upto eastern Bhutan. Recently Ripley (1951) based on two specimens collected by him from Naga Hills, separated the population of north-east Himalayas and Burma as *fulvus*. The specimens differed from nominate race by being smaller and darker; streaking on the abdomen less prominent and yellow wash on the forehead restricted posteriorly. In the absence of comparative material the 3 males and five females collected in 1973 in Central Bhutan may be considered as nominate *xanthonotus*.

Ecological distribution:

The Himalayan distribution of the honeyguide covers a variety of ecozones, from dry deciduous, sparsely covered rugged mountainous region of north-west through transient belts of pine and oak to broadleaved tropical wet evergreen forms of the north-east. The birds have been observed at various altitudes ranging from 1500 m to 3500 m. Ripley (1950) considered them to be altitudinal and seasonal migrants in Nepal. Elsewhere, discussing the ecological aspect he suggested that the westernmost population occurs in the coniferous and dry deciduous open forests while eastern population inhabits the dense wet tropical forests with the population in Nepal adapted to an intermediate vegetational zone.

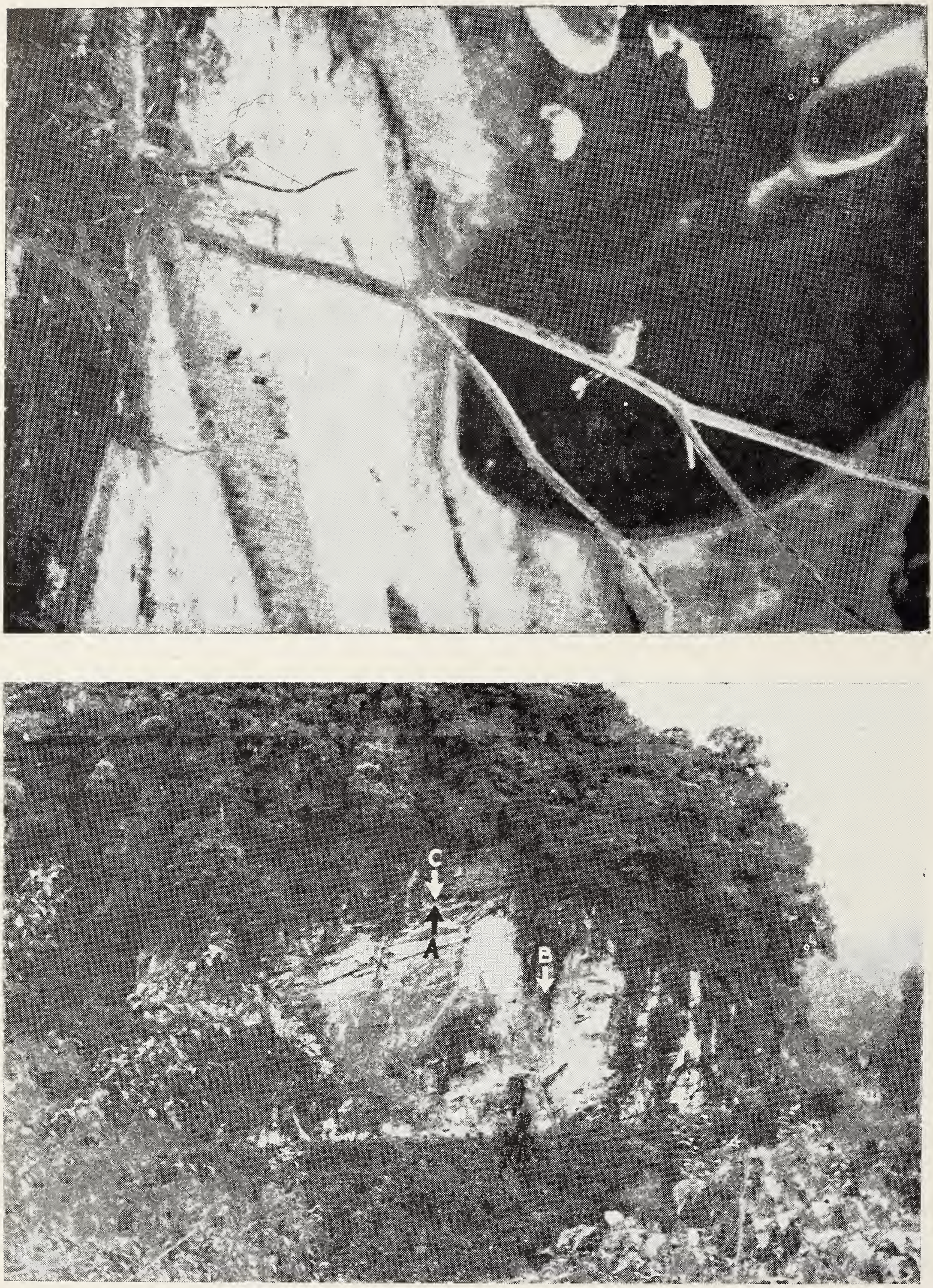
Indicator xanthonotus is perhaps distributed exclusively over a mountainous region. All the other species including the Malayan *I. archipelagicus* occur from sea level up to about 2700 m. The distribution in Africa is characterised by birds of a species occupying diverse habitats with each of its subspecies isolated in a different habitat.

Physiography and vegetation:

The Bhutan Himalayas, unlike Nepal and Sikkim, have not been explored extensively. The climatic and vegetational zones are more or less similar to the Sikkim Himalayas described by Sálim Ali (1962). However, the 'chequering' effect of the overlapping vegetational zones is more pronounced here. The foothills contain dense wet tropical forest and form an evergreen zone to altitudes upto 2500 m. North of this, roughly between 2000 to 3000 m, lies the deciduous zone and above 3000 m begins the alpine zone. The abrupt rise of the hills of central Bhutan reaches up to the Black Mountain range, the main geographic feature of the area. The range provides the major barrier to the onslaught of the S-W monsoon. The 'chequered' character of the vegetation is much in evidence on the rain shadow area. As one crosses the Gulibrong Saddle (*c.* 2300 m) a low pass over the range, and descends to an altitude of about 840 m. the dense evergreen forests give way to a dry-deciduous coniferous zone. This coniferous vegetation in its turn gives way to broadleaved forest as one climbs northwards. This irregular and overlapping vegetation is determined mainly by the elevation, exposure and climatic conditions like precipitation and temperature (Fisher 1971).

Itinerary, Study area and Method:
First trip: *May—June* 1977

S. A. H. reached Bhutan on 11th May and



Above: Rm1 sitting on "Perch A".
Below: "Honey Rock" — a study area in Bhutan. Perches A, B and C (*see* text).

immediately proceeded to Batase the Border Roads camp at Samkhara about 8 km. from "Honey Rock" — the study site. He stayed there for about 27 days from 12th May to 8th June and threafter moved north to Mangdechu *c.* 840 m. (8th-9th June), Shamgong — Khosela, *c.* 1400 m (10th-14th) Tongsa-Gyetsa *c.* 2500 m—3400 m (14th-16th), Bubja *c.* 2500 m (17th) and then on to Thimphu 2700 m (20th-25th) over Pele La *c.* 3900 m and Wangdiphodrang. From Thimphu short trips were made to Wangdi over Dochu La *c.* 3400 m and Chapcha along Thimphu Chu. A total of about 600 km were covered in central and western Bhutan by jeep and on foot.

Second trip: *October* 1977

We (SA, SAH and Shahid Ali) travelled from Thimphu to Tongsa via Wandgiphodrang. Some observations were made at Bubja, about 20 km on the Tongsa-Shamgong road, where a smaller cluster of beehives above the road hosted a single territorial male and several visiting honeyguides. A single mist net was put up about 50 ft. above the road on the rock face and a female honeyguide (the first to be trapped) was ringed. We then moved on to Batase and carried on our studies from 21st October to 30th October at 'Honey Rock'.

Study area:

"Honey Rock" *c.* 1900 m is situated on the southern side of Gulibrong saddle between 54 and 55 km on the main and only motorable road passing through central Bhutan, connecting the border town of Gaylegphug with Tongsa in the interior. There is a cluster of honeycombs under the overhang of a 80-85 ft. high open cliff face. The rainfall in this area is very heavy. The terrain is steep and rugged and contains dense moist evergreen tropical forest. Vegetation is predominantly Oak (*Quercus, Cyclobalanopsis* and *Lithocarpus*) and other evergreens characteristic of warm temperate forests, as well as epiphytes, ferns and orchids. Along the roadsides shrubs of *Rubus* sp. occur patchily. The forest is untouched except for a few patches above the road where there has been some clear felling. The nearest human habitation is about 4 km south where Nepali settlers cultivate wheat, barley and cardamom.

OBSERVATIONS: (May-June 1977)

Due to obvious reasons most of the observations were carried out at Honey Rock. Weather conditions greatly hampered observation consistency and statistical analysis and interpretation of the bionomics and behavioural patterns is not feasible here due to the lack of sufficient material. Some novel and exceedingly interesting aspects of behaviour of *I. xanthonotus* have been reported by Cronin and Sherman (loc. cit.) An attempt will be made here to fill in the gaps and also to comment upon and discuss their study in the light of the observations made by ourselves in Bhutan.

During the 1973 visit to this site about 27 birds had been seen in the course of a 2-hour session. The highest number seen in a day during the present study was three birds. One bird constantly stayed at the rock and was observed chasing/displaying/mating with birds visiting Honey Rock. It was obvious from subsequent observations that this bird was a male holding all the combs at this site as his territory. Three other sites inspected elsewhere in Bhutan also contained one resident male each.

The resident male (hereafter Rml) remained constantly at the site except for brief periods and when chasing away intruders. Saplings growing out of the cliff face were used as perches. Perch A (Plate I) was used most of the time. The significance of the various perches used is elaborated under territorial behaviour. The earliest activity of the day was observed at 5.15 a.m. and the last at 7.50 p.m. when the bird finally settled on the perch A apparently to roost.

The following notes are mainly based on the observations made on Rml at Honey Rock.

Call: Call note *chip....chip* continuously uttered in flight and also when agitated. The latter invariably preceded the arrival of an alien honeyguide.

Flight: Flight is straight and direct. Some time wheeling and manoevering like a sparrow when flashes of orange rump are visible. The flights reminded SA of 'bayas chasing one another at a nest colony'. Baker's (1927) statement that it has a 'heavy and dipping flight like a larger and more clumsy Barbet' is not true in the case of the birds studied. Moreover, unlike most of the barbets and woodpeckers which have rounded wings, the wings of Orangerumped Honeyguide are narrow and pointed and we noticed no undulations in its flight.

Preening: Preening was observed in detail on three occasions. The bird commenced preening soon after a feed at a honey comb. Initially it wiped its bill on the branch and proceeded to preen.

First the primaries by fanning out a wing. Each primary is then nibbled and drawn out from base to tip. Wing-coverts, upper back and scapulars are dealt with next by stretching the head over the shoulder. The process is repeated on the other wing. The bird then proceeds to preen the tail feathers, first nibbling at the base and drawing out each feather. Head scratching is done by the direct method, that is, bringing the foot up from under the wing. Simmons (1961) has suggested that prior to preening the birds, obtain oil from preen gland by rubbing the bill over the base of the tail. In this case the birds did not appear to obtain any oil from the preen gland. Since the bird had fed on the wax just before could it be that it was using the waxy substance adhering to the bill instead. This aspect needs investigating.

Characteristic postures:

Most of the time Rml sat on perch A motionless yet alert. Sometimes it fluffed its body feathers and 'squatted' with wings dropping at side like a brooding bird. It sat on smooth branches and avoided damp moss and other epiphytes. While feeding on the dry flaky wax of deserted empty combs the bird clung to the comb with its abdomen and tail pressed against the structure. It pecked at the comb by stretching the neck forward. After each peck the bird nibbled the wax in its beak, as if chewing, before taking the next mouthful. It moved along the comb in a series of hops, very much like a sparrow.

Food and feeding habits:

On the first day of observation (12 May) feeding on the honey comb was not observed though the bird alighted twice on one of the combs. However, it was seen sallying up in the air like a drongo hawking insects. On the following day it was observed at a rock crevice well above and away from the combs. It appeared to peck at something by inserting its head inside the crevice (vegetable matter?) Feeding at the wax was observed on nine occasions, each feed lasting from a minimum 3 minutes (15 pecks) to a maximum 22 minutes (82 pecks). Visiting birds were seen on five occasions (only one bird at a time). The visitors' feeding was always interrupted by the arrival of Rml. The longest time a visiting bird fed was for about 20 minutes. This bird had arrived during the resident male's absence, (while it was chasing another intruder) and was not seen feeding at a comb by Rml when he returned.

The birds fed chiefly on the foundation wax adhering to the rock. They were not observed to disturb the bees or attempt to feed from an active hive. The brown portion of one particular comb measured about 75 cm long, about 45 cm wide and about 5 cm thick. The total estimated area of a fresh comb would be 75 x 60 x 10 cm, of which 15 per cent comprised of white foundation wax.

Territorial behaviour:

As mentioned earlier Rml seldom left the rock site except when chasing off an alien honeyguide. Every visiting honeyguide was challenged by the resident male. At the approach of an intruder, Rml showed considerable agitation, by simultaneously flicking his wings, jerking his body restlessly and calling continuously. He then shuttled between perches A & B (comb check) occasionally 'dive bombing' the alien, and attempting to mount (Female?) or chase it away (Male?). On one occasion, after chasing an alien it flew in a slow circle in front of the rock uttering a call *chaenp....chaenp.*

Apart from Rml at Honey Rock four other territorial males were noted at Chablekhola *c.* 2000 m (one), Bubja *c.* 2500 m (two) and Tongsa *c.* 2500 m (one). At Chablekhola (6 km north of Honey Rock) the resident male was observed for about 8 hours. During this time two alien birds visited and were chased away by the resident. At Bubja two males held territories about 50 m apart on a curved rocky hillside. The two territories were screened from one another by the jutting curve of the rock. One held six old combs and two active hives and the other contained 15 old combs and 10 active hives. About 100 m down hill there was another spot with 15 active hives but no old combs. No bird was noticed there. The birds were observed for about 6 hours and though they did not leave their respective territories, no visiting honeyguides were seen.

Display and mating:

It was not clear whether honeyguides have a regular courtship but some display by Rml was observed whenever a visiting honeyguide arrived to feed at the comb. It alighted near the visitor and started flicking its wings, head held high with bill pointing upwards, feathers fluffed and chest held low, the orange of the rump exposed and conspicuous. The bird swayed its body from side to side. The entire procedure was reminiscent of the arrogant display of cock house sparrow. The resident Rml then followed the alien all over the comb continuing the display while the newcomer either ignored it and continued to feed (female) or flew away (male?) chased by Rml.

Mating was observed on two occasions. On 15th May Rml twice approached a visiting bird and started displaying. On the first occasion the visiting bird ignored him and disappeared behind comb and fed for about 8 minutes. In the meantime Rml went to perch B. When the visitor came out to feed on the upper portions of the comb Rml went up to it and started the display once again. This time the visitor (female) also started flicking the tail, pressed its body and tail down, wings dropping and neck stretched forward. Rml attempted to mount but fell back. It mounted a second time, and copulation lasted for about ½ second. Rml then flew back to perch B while the female continued to feed and flew away after 6 minutes.

A second mating was observed the same day. Two birds arrived at the site. One was chased away by Rml while the other sat on perch B. Rml returned and spotting the alien sitting on B went and sat alongside and at once tried to mount by perching on its back for about 15 seconds wings fluttering, repeatedly attempting to copulate. He made a second attempt to mount but this time both the birds fell from the perch and spiralled downwards with their feet locked together. They broke away about a meter from the ground and sat on a nearby rock. The visitor then flew away while Rml went back to perch A.

Other associations:

Honey Bees: The association of the honeyguides with the rock bees (*Apis dorsata*) appears to be indirect in so far as the bird is only interested in the wax of the abandoned honey combs. While bees tend to ignore the presence of the honeyguides, the birds did not appear to molest the active hives. There were occasional large scale 'dog fights' among the bees apparently belonging to different hives in the vicinity, and the whole rock face would be swarming with bees. When this happened Rml remained motionless on its usual perch. On several occasions it fed from comb hardly six inches from an active bee hive without causing any disturbance to the bees. An interaction of rockbees, wasps and the honeyguides was recorded during the second trip (Hussain and Ali 1979).

Other species of Birds: Some time was spent observing the breeding activities of other birds in the vicinity of Honey Rock. The following species were noted: Verditer flycatcher (*Muscicapa thalassina*), Himalayan whistling thrush (*Myiophonus caeruleus*) (below the honey combs): Bluebearded bee-eater (*Nyctyornis athertoni*), all feeding young at nest near Honey Rock; Greyheaded flycatcher-warbler (*Seicercus xanthoschistos*), Chestnutheaded Flycatcher-warbler (*M. castaniceps*), Barbets *Megalaima virens* (family parties), *M. franklini* (excavating nest hole), *M. asiatica*, Chestnutbellied Rock Thrush (*Monticola rufiventris*), Sibia *Heterophasia capistrata*, Greywinged Blackbird *Turdus boulboul*, the Woodpecker (*Picus flavinucha*, *Dendrocopos canicapillus* and *Blythipicus pyrrhotis*), Sipahi Finch *Haematospiza sipahi*, Dipper *Cinclus pallasi*, Forktail *Enicurus maculatus* and Grosbeak *Coccothraustes melanozanthos*.

It was not possible to ascertain whether the honeyguides were in any way directly associated with these birds. The resident male (Rml) was occasionally chased by a pair of Drongos (*Dicrurus* sp.) that visited the rock to hawk small insects. When this happened Rml abandoned its usual perches and sat on the trees on the periphery of the rock. It generally tolerated other small species of birds near its perch. Once it chased a pair of Redwinged Shrike-babblers (*Pteruthius flaviscapis*) that ventured too close to perch A.

Other Vertebrates:

A troop of Rhesus (*Macaca assamensis*) were observed among the trees above Honey Rock in the evening at about 6.30 on 6th June. They were preparing to roost on the trees overhanging the rock and the resident male honeyguide was very much alarmed by the activities of the monkeys. It flew in front of the rock calling repeatedly and avoiding its usual perches, sat on trees on either side of the rock, all the time flicking its wings agitatedly. It finally settled for the night on a branch well away from the rock at about 7.15 p.m. The troop was still there when I (SAH) reached the place next morning at 5.15. The bird was not seen at the site till 7 a.m. three years ago His Majesty's government passed a law banning extraction of honey. That most

TABLE 1

	Area	Habitat	Honey combs old/active	Hrs/obs	Res. Male
1977	Batase Bhutan *c.* 1900m	Broadleaved tropical evergreen forest	9/11	—	1
	Chablekhola Bhutan *c.* 2000m	-do-	7/4	8 hrs	1
	Shamgong Bhutan *c.* 1400m	As above (but no covering trees around the spot)	15+/8	10 hrs	not seen
	Bubja 1 Bhutan *c.* 2500m	Broadleaved tropical evergreen forest	6/2	5 hrs	1
	Bubja 11/ Bhutan *c.* 2500m	„	15/10	5 hrs	1
	Tongsa Bhutan *c.* 2600m	„	6+/4	2 hrs	1
	Gyetsa Bhutan *c.* 3300m	Coniferous	4+/3	6 hrs	—
	10 km from Wangdi Podrang Mixed forest Bhutan *c.* 1400m	Mixed forest	4+/3	2 hrs	—
	Along Thimphu river/ W. Bhutan 1400-2000m	Open Coniferous	about 40/60 scattered along the river course	24 hrs	—
1978	Gangharia 2570m. Garhwal Himalayas	Coniferous	6+/10	3 hrs	1
1980	Namdapha *c.* 1366m E. Arunachal	Evergreen	?	—	—

* the beehives were glassed from a distance of 1000 mts. and the birds were seen.

of the old honey combs at the rock stand untouched could be explained by this fact. However, a considerable area above and beside Honey Rock has been disturbed owing to clear felling of the forests.

SURVEY

Efforts were made to locate as many honey comb sites as possible. Enquiries made with the Forest Department, Border Roads Organisation and local people revealed several such spots in central and western Bhutan. Some of the areas were not accessible owing to the adverse weather conditions. Those investigated, together with further information gathered elsewhere in the Himalayas, are listed in Table 1, also see Hussain 1978.

OBSERVATION OCTOBER-NOVEMBER 1977

Mist netting and Marking:

During the second trip efforts were made to capture and mark the birds. Cronin and Sherman (1977) had successfully colour-ringed honeyguides in Nepal by luring them to pieces of honey combs placed near a mist net. We put up a single net at Bubja on a steep rock cliff among the clumps of bushes, about 30 ft. above the base of the rock. Though no bait was offered a single ♀ was trapped in the net after an hour's operation. Subsequently we operated two nets at Batase, sometimes baited with wax, and captured and ringed 12 honeyguides (see Table 2).

Behaviour:

There appeared to be a marked increase in the number of honeyguides observed during this period than in May-June. On the first day of our observations at Honey Rock, 20 honeyguides were seen within a period of 8 minutes. The territorial male Rml, (Was he the same as in May-June?) seemed to be under considerable stress from visiting alien birds. About

TABLE 2

Indicator xanthonotus RINGED IN BHUTAN 1977

Ring No.	Sex	Age	Date	Place	Colouring	Recapture
A—163820	♀	Ad	18/10	Bubja	Orange RL	—
21	♀	,,	21/10	Batase	Red RL	27/10/72
22	♂	,,	21/10	,,	Yellow RL	—
23	♂	FG	21/10	,,	Green RL	—
24	♀	AD	21/10	,,	White RL	—
25	♂	,,	21/10	,,	Red LL	28/10/77
26	♀	,,	21/10	,,	Purple RL	28/10/77
27	♀	,,	27/10	,,	No colour	—
28	♀	,,	28/10	,,	Rose RL	—
29	♀	,,	28/10	,,	Green LL	—
30	♀	,,	29/10	,,	White LL	—
31	♀	,,	29/10	,,	Orange LL	—
32	o?	FG	29/10	,,	Yellow LL	—*

RL = Right leg
LL = Left leg

* Colour of feet greenish, general body moult.

14 active hives were present and the number of old combs appeared to have decreased greatly. Considering the fact that 25 birds were counted in 2 hours in October '73 and about the same number in October '77 and only a few were seen in May-June (though old combs were a plenty) it was apparent that there may be some kind of seasonal movement of the honeyguide population. One of the factors that perhaps contributed to the concentration of birds in October-November may be scarcity of food elsewhere. It is possible that the old combs were washed away during the rainy season (June-Sept.) Competition for a few available old combs is intense in winter. This fact was borne out by our observation in Oct.-Nov. The resident male at Honey Rock was not only under constant pressure but also appeared to be unable to ward off the intruding birds from his territory. Far too many birds challenged his 'ownership' of the combs for the territorial male to defend such a large area. Thus not only the defended territory decreased but the male was actually forced to tolerate more aliens near his territory.

The intensity of activity around the rock was maximum during early morning and late evenings when the rock was in the shade. As the day advanced and larger areas of the rock became exposed to sunlight the honeyguide activities slowed down. Activity patterns of the honeyguide were studied from 7.45 a.m. to 4.15 p.m. each day five days consecutively, from 21st to 25th October. During this period, movements of the Rml and his interactions with other honeyguides were noted. A total of 45 hours observation was made. On several occasions the honeyguides were seen hawking flying insects. Feeding on the comb by Rml was observed (½ minutes 35 pecks to 4½ mt./1045 pecks).

SUMMARY

The study was mainly an explorative investigation and its limited scope does not allow for a comprehensive interpretation of the data gathered.

Food Resources:

Bees wax appeared to be the main food source for the honeyguide in Bhutan. The birds fed on the white foundation of abandoned honey combs. They also took insects, but not honey bees or their larvae, or the honey itself. They were also observed to feed on some vegetable matter. Cronin and Sherman (loc. cit.) mention about the wax eating habit of *I. xanthonotus* in Nepal. They also report honeyguides taking insects and vegetable matter. The digestibility and nutritional value of bees wax has been discussed by Friedmann (loc. cit.) Cerophagy or wax eating among the honeyguides cannot essentially be a congenital trait of the family Indicatoridae, since many species of African honeyguides are brood parasitic on frugivorous birds like barbets which raise thier own young mainly on insects and fruits. There would be little chance of the fosterling surviving if its main food in the nestling stage was wax. At what stage of their life history the birds acquire the wax-eating habit? and how? needs to be studied. The importance of honey combs on the reproductive behaviour of the Himalayan Honeyguide as noticed by us during this study, tends to support the novel interpretation of Cronin and Sherman who have termed their mating system as "Resource-based non-harem polygyny" (loc. cit.). The male holds a bees' comb, or group of combs, as his territory throughout the year and mates with all receptive females that visit it to feed during the

breeding season. These may total up to 20 or more. Males without a territory apparently seldom get a chance to mate.

As mentioned earlier, there is heavy concentration of honeyguides during winter months leading to intense competition for limited food resources. This in a way confirms Ripley's comments (loc. cit.) that there is some altitudinal 'migration'.

The present study indicates that the Orange-rumped honeyguide is not so rare in the Himalayas as heretofore believed. However, some thought has to be given to its preservation because of its highly specialised feeding habits, and steps taken to prevent overexploitation of the wild honey potential with expanding "development" over most of its habitats.

ACKNOWLEDGEMENTS

The Royal Government of Bhutan very kindly gave us permission for this study, and extended all help during our stay in the country. The Forest Department of the Kingdom extended transport facility for the survey around Thimphu. The Border Roads Organisation considerately provided transport, boarding and lodging throughout their network.

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BIRDS OF THE RAJPIPLA FORESTS — SOUTH GUJARAT[1]

WITH NOTES ON NESTS FOUND AND BREEDING RECORDED
&
SOME NEW OBSERVATIONS

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INTRODUCTION

The Rajpipla forests, once the hunting preserve of the Maharaja of Rajpipla, lie in S.E. Gujarat at the western extremity of the Satpura range in Central India (21° 50′N, 73° 30′E), and comprise the highland area of the Satpura mountain range between the Tapti and the Narmada rivers. These forests fall into the tropical semi-evergreen and tropical moist deciduous types. The town of Rajpipla, which also was the capital of the former princely state, lies just beyond the northern edge of the Satpuras on the banks of the river Karjan (a tributary of the Narmada), a few kilometres before it meets the Narmada. This forest range once abounded in game and was particularly famous for its tigers. Many a celebrated guest of the Maharaja has bagged his tiger here. Today there are none or few tigers, which sometimes stray in from the nearby MP border. We saw a few barking deer, wild dogs, wild boar and observed tracks of hyena, jackal, leopard and sloth bear.

Though some areas of these forests have been opened up due to logging operations, they still support a large variety of birdlife. It has been observed that the void created by the clearing of forests and their subsequent replacement by agricultural activities has created habitat more suitable for openland and grassland birds. There also are biotopes of semi-evergreen moist deciduous forests and ample forests of bamboo and it is in such patches that we observed some species of birds which have hitherto been unrecorded in Gujarat. More about this later. However, we noticed that in most areas, the forests are being severely depleted due to logging and it is only hoped that the planned sloth bear sanctuary in the Piplod area will be implemented. Our main idea of visiting these forests was to investigate the possibility of photographing various species of birds of prey and to record their nesting habits and behaviour. But as our observations and notes in the course of subsequent visits have revealed in these forests, the presence of several species of birds which do not appear to have been previously recorded north of the Tapti river, and some of these are additions to the Gujarat ornithology. Some of these birds are: *Hemicircus canente, Copsychus malabaricus, Zoothera citrina, Nectarinia zeylonica, Cuculus micropterus, Acridotheres fuscus, Myiophonus horsfieldii, Motacilla indica, Pycnonotus jocosus* and possibly *Nectarinia minima.*

The presence of some of these birds in the Rajpipla forests at the western end of the Satpura mountains, provides good evidence to

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the Satpura hypothesis explained by Dr. S. L. Hora. The Satpura hypothesis postulates that the Satpura-Vindhya trend of mountains, stretching across India, was once more elevated and moister than now, and with a more temperate climate. It was continuous with the Assam hills in the east and with the northern end of W. Ghats in the west, and thus served as a causeway for spread of specialized Himalayan flora and fauna to the S. Indian hills and to Sri Lanka.

We actually found over 50 species of birds breeding in the forests and in the surrounding areas. Many of these are new breeding records as several birds have not been previously found breeding in Gujarat and in the concerned area. SGM concentrated his efforts on making the checklist while RKN concentrated on the nesting behaviour of Raptors

We visited the Rajpipla forests on seven occasions during the last 21 months:

4th June to 14th June 1981	(RKN & SGM)
17th June to 5th July 1981	(RKN & SGM)
1st January to 6th January 1982	(RKN & SGM)
10th May to 12th June 1982	(RKN & Neil Soares)
19th July to 22nd July 1982	(Only SGM)
10th December to 13th December 1982	(SGM & Eric D'Cunha)
21st January to 24th January 1983	(RKN & SGM)

LITTLE CORMORANT (*Phalacrocorax niger*)

Occasionally seen on the Mozda river. On 21st July 1982, a solitary bird was seen carrying a twig and flying over the forest at Namgir towards Mozda. There certainly should be a breeding colony nearby. This cormorant is quite common on the Narmada river and also on the Karjan.

LITTLE GREEN HERON (*Ardeola striatus*)

Only once seen behind the mission at Dediapada on 21st July 1982. There was a solitary bird and close-by were a few Pond Herons.

POND HERON (*Ardeola grayii*)

Sometimes seen along the Mozda river, at times even inside the forest. On the evening of 10th December 1982, one of us (SGM) when walking along the Mozda river along with Eric D'Cunha, observed a huge eagle fly from the tamarisk vegetation on the riverbed. The eagle was carrying a Pond Heron in its talons and this it dropped in the water. This heron was a fresh kill and there was only a slit running from the throat downwards.

The Pond heron is common along the Narmada, around Rajpipla town etc.

CATTLE EGRET (*Bubulcus ibis*)

A common bird. Seen sometimes even in deep forest clearings and along forest streams. There is probably a breeding colony near Rajpipla town.

LARGE EGRET (*Egretta alba*)

The only place we saw *E. alba* was in the vicinity of Wadhwana tank near Dabhoi, about 25 kms. north of the Narmada river.

LITTLE EGRET (*Egretta garzetta*)

Whenever we have gone to these forests we have observed a solitary bird along the Mozda river. Right from behind the Mozda ashram to well past Piplod we have seen a solitary Little egret on the riverbed (a distance of about 6-7 kms.). This bird has a very peculiar way of procuring its food as it jumps and ballet-dances over the water and chases small fish. At times, however, there would be 3-4 little egrets on the riverbed. Observed on Karjan too.

NIGHT HERON (*Nycticorax nycticorax*)

On 21st July, 1982, three birds were seen a few kilometres from Dediapada. This is the only occasion we have come across this heron here. However, we feel it should be more common in the surrounding countryside. We have seen it around Chandod near the Narmada and also in the neighbourhood of Dabhoi.

WHITE IBIS (*Threskiornis aethiopica*)

Sometimes a few birds would be present at the water's edge on the bank of the Narmada river, occasionally along with Black Ibises. We did not come across this ibis elsewhere.

BLACK IBIS (*Pseudibis papillosa*)

Seen in parties of 2-4 birds on the Narmada river.

BRAHMINY DUCK/RUDDY SHELDUCK (*Tadorna ferruginea*)

Two birds were seen on 7th January 1982 on the Narmada river. Both were at the water's edge.

LESSER WHISTLING TEAL (*Dendrocygna javanica*)

Over a hundred of these teals were seen on the Rajpipla side of the Narmada river in June 1981. Between 3rd-11th June 1981, we saw these ducks almost everyday. They would be on the riverbank throughout the afternoons. Again on 5th July the same year, four of these ducks were observed on the river.

BLACKWINGED KITE (*Elanus caeruleus*)

During the years 1981-82, we observed this kite breeding in the compound of the PWD rest house (PWDRH) at Dediapada. The birds were seen copulating on 30th June 1981 and the following year we saw them mating on 21st July. While in 1981 June the pair was busy making its nest in two places on two different trees (they were taking long thin twigs and placing them in both the trees and only in one of these trees was there any structure which appeared anything like a nest. It was rather similar to the nest of a crow). In 1982 the first clutch (eggs) of this kite was destroyed by human interference. During March-August 1983, RKN frequently observed this Kite in forests around Mozda and elsewhere.

CRESTED HONEY BUZZARD (*Pernis ptilorhynchus*)

In June 1981, a pair of these buzzards were observed making a nest (24th June) on a 'timru' (*Diospyros melanoxylon*) tree. The following year, a nest of this bird, with two eggs in it was found, again on a *timru* tree on 16th May. Rather unfortunately, due to reasons yet unknown to us, a few days later we found the eggs smashed and the shells were collected from the burnt ground below the nest-tree. The eggs were pale creamish in ground colour with blotches of dark brown.

COMMON PARIAH KITE (*Milvus migrans*)

Only on two occasions have we seen this bird flying anywhere around or over forest. It is hardly to be seen around Dediapada. Gets commoner as one moves towards Rajpipla town and is seen in good numbers around Chandod.

BRAHMINY KITE (*Haliastur indus*)

Seen on 22nd July 1982 on the Mozda river. The bird flew towards the forest. The only other occasion we ever saw this kite was near Chandod, not very far from the Narmada river.

INDIAN SHIKRA (*Accipiter badius*)

Common throughout the forests. In 1981, owing to our reaching the forests late in the season (17th June), most of the nests of this hawk were empty, the nestlings having flown away. Only one nest contained a full-fledged nestling on 25th June.

In the following May (1982), several nests of this hawk were seen and near one of these nests a hide for photography was built. This nest contained two downy nestlings and one addled egg which did not hatch and infact disappeared from the nest after a few days. The birds are very common, though less noisy during the cold season (December).

WHITE-EYED BUZZARD (*Butastur teesa*)

Twice seen around Dediapada in June 1982 and once around Chandod, north of the Narmada river. Several seen during a drive from Rajpipla town to Dediapada.

CRESTED HAWK EAGLE (*Spizaetus cirrhatus*)

There are two huge nests of thick twigs built on tall 'haldu' (*Adina cordifolia*) trees in forest. While at one of these nests we never observed any bird, at the other and also often in its vicinity we sometimes noticed *S. cirrhatus.* Our adivasi friend Banga informed us that these eagles had bred earlier in the year (finished by about April). The nest at which we had observed this eagle was found almost in shambles and completely broken in mid-December when one of us (SGM) had been to these forests. This condition of the nest was due to the cyclone in the first week of November, according to the adivasis.

BONELLI'S HAWK EAGLE (*Hieraaetus fasciatus*)

We have seen this eagle flying over light forest near Mozda, and settling on a dry teak tree-top. The multibanded tail with a dark subterminal broad band and the very pale underparts streaked on the body and lightly banded on the wings coupled with the absence of any crest were unmistakable.

EAGLE (*Aquila* sp.)

Only once have we seen a large dark brown eagle (unmistakably an *Aquila*) flying over forest.

INDIAN LONGBILLED VULTURE (*Gyps indicus*)

Seen in the Rajpipla town area once. However in mid-December SGM and Eric D'Cunha found this vulture fairly common around Mozda. An adivasi informed that these big birds (pointing towards the vultures) nest in rocks in a big hill in the forest. We wonder if some *G. indicus* also breed in the Rajpipla town area where a large number of *G. bengalensis* were nesting in December-January.

WHITEBACKED VULTURE (*Gyps bengalensis*)

Abundant in Rajpipla town and neighbourhood where on almost every large roadside tree one, two and even more occupied nests (with nestlings) were seen in December and January, 1981-82. Seen often around Dediapada, Mozda, and also flying over forest. Common also north of the Narmada river.

WHITE SCAVENGER VULTURE (*Neophron percnopterus*)

Sometimes seen in Rajpipla town and in the neighbourhood. Seen also at Dediapada and once along the Samot road in forest behind Mozda. One of us (RKN) saw it once at

Namgir in forest. SGM found it breeding in the first week of May near Baroda.

MARSH HARRIER (*Circus aeruginosus*)

A solitary bird seen near the PWDRH at Dediapada and once near Netrang in December 1982. A winter visitor.

CRESTED SERPENT EAGLE (*Spilornis cheela*)

Undoubtedly the commonest raptor in these forests. Its *keeee...ke...kee* calls are frequently and very commonly heard. As many as five nests of this eagle were found and checked in June-July 1981. Only two of these nests were occupied though a third nest located deep in the forest had an adult eagle sitting in it. This nest was however, found to be empty on checking. Out of the two occupied nests, one at Sankhdi contained a full-fledged eaglet while the other nest had a week-old eaglet when first checked on 18th June. This particular nest was photographed till 4th July and we presume the eaglet to have left its nest sometimes in the first or second week of August.

In 1982, a nest of this eagle was found in forest around Namgir (where RKN was camping) on 13th May. This nest was on a 'sadada' (*Terminalia tomentosa*) tree and it contained one egg when first checked on 13th May which hatched (presumably) on/around 17th May (Actually RKN first found a tiny eaglet on 20th May and we only presume it hatched around 17th May). A machan was built near this nest which was photographed till about mid-June. The eaglet at this nest left the nest on 20th July (SGM).

On 1st June another nest of this eagle, with a small eaglet in it, was found on a 'shishum' (*Dalbergia sisoo*) tree, in forest near Mozda by Bhanga & RKN. We observed that, especially around Namgir, the nests of *Spilornis cheela* are not located very far from each other and that most of these nests were on *Terminalia tomentosa* trees. Further it was noticed that this eagle breeds somewhat later here as compared to other areas. Though in Vol. 4, of NIDIFICATION Stuart Baker writes of this race as breeding from Dec.-March in Travancore, Feb-March in Konkan, he also distinctly mentions that it breeds later (Feb-June) Northwards, i.e., Maharashtra, Gujarat etc., however, we found that in the Rajpipla forests the breeding season of *S. cheela melanotis,* in several cases examined, had extended well past July. In MP, this eagle breeds in March-May (Birdlife in Madhya Pradesh, C. E. Hewetson, JBNHS 53: 630). Thus we feel safe to state that the breeding season of *S. cheela melanotis* in the Rajpipla forests on the Satpura Range in South Gujarat is around mid-April-May to July-August.

KESTREL (*Falco tinnunculus*)

Seen at Dediapada once on 10th Dec. 1982.

PAINTED PARTRIDGE (*Francolinus pictus*)

SGM recalls having heard this partridge in scrub around Dumkhal.

JUNGLE BUSH QUAIL (*Perdicula asiatica*)

On more than two occasions a small flock of quails flew off with a whirr from almost under our feet. The birds flew off from thick grass and landed on a forest path nearby and immediately moved into the surrounding grass cover. We also came across such small flocks of quails in forest around Juna-Rajpipla and around Piplod and Dumkhal. Except on one occasion we never quite managed to get a good glimpse of the quails inorder to correctly identify them. Only once were *P. a. asiatica* observed very clearly for a brief period on a forest path. The small party consisted of two males and five females.

RED SPURFOWL (*Galloperdix spadicea*)

Though we never saw these birds we recognized their calls on a couple of occasions. Some adivasis when shown pictures of this bird recalled having hunted this spurfowl occasionally.

RED JUNGLEFOWL (*Gallus gallus*)

On the morning of 22nd June, 1982, SGM saw this Junglefowl in deep forest a few kilometres behind Namgir. It was raining lightly. There were two females alongwith one male and they were observed from hardly about 60-75 feet away with binoculars. It was actually when some drab coloured ground birds crossed SGM's path that his attention was first drawn towards them. The birds moved into a somewhat open clearing and were immediately followed by a male Red Junglefowl. When SGM first saw the two females it was clearly noticed that they were appreciably different from the females of Grey junglefowl which SGM has often come across in the Borivli National Park in the neighbourhood of Bombay. These two females lacked the black and white markings of the *G. sonneratii* female. Hardly had the females been observed for a few seconds when a male Red junglefowl appeared into the open. Both the females and the solitary male disappeared into the forest soon. For some time the birds were preening and the drab females and the colourful male were close to each other. It is quite unlikely that these were domestic fowls, because the nearest adivasi hamlet was only Namgir (our camp-site) and the few domestic fowls that the adivasis keep would certainly not venture so many kilometres deep into the forest for they normally keep to the adivasi huts. Moreever, SGM on later having a look at all the fowls of the advasis was convinced that it was not any of the domestic fowls that had strayed so far in the forest.

Incidentally, when SGM returned back to Bombay and checked Vol. 2 of HANDBOOK OF THE BIRDS OF INDIA AND PAKISTANS by Sálim Ali & S. D. Ripley, he was surprised to note that almost a hundred years ago the Red Junglefowl had been observed in the Rajpipla hills (exact area not mentioned) by Jerdon. Ripley in 'SYNOPSIS' mentions the occurrence of *G. g. murghi* in the Gujarat Satpuras.

GREY JUNGLEFOWL (*Gallus sonneratii*)

This bird is much persecuted by the local adivasis and it is only rarely that one can possibly see this junglefowl in the forest. In the course of six visits by us, we have managed to see this bird only twice. Even its calls are rather uncommonly heard. No evidence of breeding.

COMMON PEAFOWL (*Pavo cristatus*)

North of the Narmada river in the dry ravine countryside around the Narmada at Chandod the Peafowl is extremely common, and very tame too.

South of the Narmada it is for less common. In the forests it is less common still. Here we have more often heard it, particularly on rainy nights when the calls of this bird and those of *Cuculus micropterus* are frequently heard. We have only three actual sightings of the Peafowl in forest. An adivasi informed us of having found eggs of *P. cristatus* in heavy undergrowth in August.

Strangely, we noticed that the peahen is hunted by the adivasis while the cock is spared owing to religious sentiment.

WHITEBREASTED WATERHEN (*Amaurornis phoenicurus*)

Common on the Mozda river, seen sometimes even along deep forest streams. Occasionally seen along the river on Samot road. Often around Dediapada, particularly in the neighbourhood of the PWDRH compound. Breeds during the rains. A nest found in July (21st) in a dense bush on the Mozda riverbed contained two eggs. Calls of this bird heard *ad nauseum.*

RED-WATTLED LAPWING (*Vanellus indicus*)

An adivasi reported a nest of this bird containing two eggs in May 1982. This was on the stony bed of a forest stream and when checked later both the eggs had been taken by someone. A few pairs of this lapwing are always to be seen on the stony bed of the Mozda river and of the other forest streams which are dry for most part of the year except during the rains. Occasionally this plover is seen on paths in thick forest too and it is one of the few openland birds that has settled in good numbers in forest clearings and in croplands right in the middle of deep forest. It is often seen around Dediapada and all around in the open wastelands and cultivated countryside.

It is however, around the Narmada river and north of this river that *V. indicus* happens to be a very common bird and here we found several nests in June. Most of these nests had clutches of four eggs each while one contained only three eggs.

GREY PLOVER (*Pluvialis squatarola*)

A bird of the seashore and marshes, naturally SGM was surprised when he saw this bird on the Mozda river (at Mozda) on 10th December 1982 when birding alongwith Eric D'Cunha. The white upper tail and rump and a whitish wing bar, in flight the black axillaries on the wing underside, the greyish plumage and the typical plover beak were unmistakable.

LITTLE RINGED PLOVER (*Charadrius dubius*)

The two races, *C. d. jerdoni* and *C. d. curonicus* are difficult to be distinguished in the field. A small flock of 11 birds was seen on a rainy morning (21st July 1982) on the Mozda riverbank. We found this plover common on the Narmada banks, on the sandy and stony shore of this river where the birds were breeding in May-June. A nest was found on 5th June. It contained one egg and two just hatched young birds. It was very hot in the afternoon when SGM found the nest and the adult birds were frequently going towards the water where they would wet their underside and come and sit over the egg and the young birds, certainly because of the intense heat (it was around 43°C.). The birds would wet their undersides every few minutes, by wading into shallow water and bobbing up and down to wet their lower body. We put up the machan about 2 feet from the nest and RKN photographed the birds for over two hours in the afternoon. The remaining egg did not hatch. The eggs and the young of this plover are almost impossible to locate among the stones from even as close as one foot distance even when the nest has been previously spotted. The young birds on leaving the nest sit tight in some depression or among stones, lying flat with their wings spread and are absolutely impossible to locate.

GREEN SANDPIPER (*Tringa ochropus*)

In December 1982, SGM found this sandpiper common in the area. Almost every stream in forest had one or more of this sandpiper in its vicinity. This dark sandpiper with its almost squarecut white upper tail is a lovely sight on a forest stream as it flies rapidly from somewhere nearby on approach, with a sharp *tiu..tiueet..tiueet*...call. The bird is a winter visitor and we have come across it on the Narmada too.

WOOD OR SPOTTED SANDPIPER (*Tringa glareola*)

This sandpiper can be readily distinguished from the preceding species by its paler upperparts and much paler underwing, and the white on upper tail, squarely cut from the brownish body. This sandpiper appears to be a less common winter visitor to the area. We have seen it only twice around Mozda river. Also seen on the Karjan, Narmada and also around Rajpipla town and behind the PWDRH at Dediapada.

COMMON SANDPIPER (*Tringa hypoleucos*)

Seen near Dediapada in January 1982 and also on the Narmada river where we once came across a solitary bird in mid-June. Appears to be an uncommon winter visitor to the area. Seen also on Karjan in January 82.

LITTLE STINT (*Calidris minutus*)

A pair of these stints were seen on the Narmada in Jan. 1982. Not observed elsewhere.

BLACKWINGED STILT (*Himantopus himantopus*)

In June and July we have often come across small scattered parties of this bird on and around the Narmada river where we have observed the birds feeding on marshy ground around the river and at the water's edge. During these two months we noticed that there were quite a few immature birds too, thus suggesting that the birds had finished breeding. They probably breed on the banks of the Narmada nearby. Seen also in December-January.

GREAT STONE PLOVER (*Esacus magnirostris*)

In June 1981, we always saw a pair of these plovers on the banks of the Narmada river on its south (Rajpipla) side. The adult birds were always accompanied by two smaller and paler birds which were immatures, thus indicating that the plovers breed early in the year, probably from mid-April to June. The adult birds, and also the immature birds spend most of the hot hours of the afternoons sitting tight among the stones on the riverbank. The birds hardly move and are very difficult to spot.

SMALL INDIAN PRATINCOLE (*Glareola lactea*)

Surprisingly there is no mention of this bird for Gujarat by Salim Ali in 'Birds of Gujarat', (*JBNHS* 52; 2, 3 & 4).

On the banks of the Narmada river we found this pratincole abundant in June 1981. The birds were always very active, frequently dragging themselves on the sand and many a time they fooled SGM into believing that they were breeding. But the breeding season was certainly well past as was clear by the presence of so many immature birds which could be readily recognized by their dark spotted throat and breast and their upper body which had a kind of scaly appearance. But what were the adult birds doing by dragging themselves along and pushing one another, frequently uttering a very faint chuk...chuk calls or a chirrr..rit ..chrr..rrtt as they would fly above for a short while? The birds always seemed to keep to the broad sandbanks of the Narmada river and it was clear that they quite disliked the stony areas. We failed to come across any of these birds in winter when, however, we did not look very carefully on the several miles stretch of the river on either side as we had done previously.

WHISKERED TERN (*Chlidonias hybrida*)

Occasionally seen on the Narmada river. Seen also on the Karjan. Appears to be a winter visitor only.

INDIAN RIVER TERN (*Sterna aurantia*)

Comon on the Narmada river in June when the birds had evidently finished breeding. There were many immature birds too. The adult birds were still in their breeding plumage with their pitch black crown, forehead and nape. This along with their bright yellow long pointed beaks, the red legs and the deeply forked tail makes these terns a sheer treat for the eyes. The birds evidently breed on the banks of the Narmada river, on the sandbanks.

GREEN PIGEON (*Treron phoenicoptera*)

Though none of us actually saw this bird, Neil Soares who had come to the forests for a few weeks in May 1982, found a nest of this pigeon in the compound of the PWDRH at Dediapada. According to Neil the nest contained two full fledged nestlings on 23rd May. He showed the unoccupied and empty nest to SGM who did not find it to be the characteristically flimsy platform of a few twigs as has been described. This particular nest was quite a well constructed affair of thin, dry twigs and it was surprisingly well concealed in a thickly foliaged tree, about 8 feet high. It had a diameter of 10 cm.

BLUE ROCK PIGEON (*Columba livia*)

A few were seen at Piplod and also at Dumkhal in forest (about 20 and 27 kms. respectively from Dediapada). At both these places there are grain storages. A few pairs of these pigeons were also seen on the bridge along Samot road where they were apparently nesting on the underside of the bridge along with a pair of *Hirundo concolor* in June and July 1982. *Columba livia* gets progressively common towards Dediapada and are present in appreciable numbers in Rajpipla town.

RUFOUS-TURTLE DOVE (*Streptopelia orientalis*)

In January 1983 a small party of these doves seen in forest along Karjan river. A pair was also seen near Namgir.

INDIAN RING DOVE (*Streptopelia decaocto*)

A few scattered flocks alongwith other doves seen between Rajpipla town and Dediapada in January 1983. Occasionally, seen around Chandod north of the river. The nearest that we found this bird breeding was at Dabhoi in July 1981. SGM has found it breeding in good numbers around Baroda in May, June and January.

RED TURTLE DOVE (*Streptopelia tranquebarica*)

Seen about 5km from Dediapada on a walk in dry and open countryside in June (exact date not recorded) 1982. This is the only occasion we have come across this dove south of Narmada. We also saw it north of the Narmada river and it appears that this dove distinctly prefers drier and thorny scrub covered country than other doves. Commoner north of Narmada.

SPOTTED DOVE (*Streptopelia chinensis*)

This happens to be the common dove of the area. Often seen along roads in open countryside as well as in forest. It also happens to be the only dove we found breeding in the forest. Nests with eggs were found near the ashram at Mozda and also in the neighbourhood of the PWDRH at Dediapada in June. The birds were probably breeding in December too, though no nest could be found.

LITTLE BROWN DOVE (*Streptopelia senegalensis*)

South of the Narmada we have come across this dove in the dry and open country between the river and Rajpipla town and also around Karjan. North of the Narmada, SGM remembers finding a nest with one egg at Chandod which he feels belonged to this species one of which was calling nearby. The next day there was still one egg and it seems that the nest was deserted. We failed to come across this dove around Dediapada or around the forest.

LARGE INDIAN/ALEXANDRINE PARAKEET (*Psittacula eupatria*)

Dumkhal, a small adivasi village in the forest (about 27km from Dediapada) is known for its large parakeets which breed in the surrounding forests early in the year. The birds may, however, be seen all along the forests in small noisy parties, at times even at Dediapada and even in Rajpipla town. Reportedly caught and sold for bird markets.

ROSERINGED PARAKEET (*Psittacula krameri*)

Often seen at Dediapada, Rajpipla town and elsewhere. Seen also in the forest at Mozda, Namgir, Piplod, and in the surrounding forests. At Chandod the birds were apparently breeding in June.

BLOSSOMHEADED PARAKEET (*Psittacula cyanocephala*)

Often seen and heard in the forests as well as in the open outskirts of forest. A small flock was seen in the garden of a hotel in Rajpipla town. A fairly common bird.

PIED CRESTED CUCKOO (*Clamator jacobinus*)

On 21st July 1982, SGM heard these cuckoos calling incessantly in the forest when walking along Samot road. The birds were then seen chasing each other and they were very active, apparently ready for breeding. The principal recorded host of this cuckoo and of *C. varius*, is the Jungle Babbler (*Turdoides striatus*), which SGM observed making a nest in the forest on the very same day.

COMMON HAWK-CUCKOO (*Cuculus varius*)

Heard during the rains in forest. Not common.

INDIAN CUCKOO (*Cuculus micropterus*)

There is no mention of this cuckoo for Gujarat in 'Birds of Gujarat' (*JBNHS* 52: 2, 3 & 4), by Sálim Ali. However on going through notes in the BNHS we found that there is one record of *C. m. micropterus* for Gujarat. This is a specimen collected by Ernest Shull in the Dangs forests, south of the Tapti river (*JBNHS* 59: 659). This bird was collected on 14th July 1954, and its ovaries were found enlarged, thus suggesting that the bird was in breeding condition and as such breeds in Gujarat for which there appears to be no further evidence of the breeding status of this cuckoo.

We found *C. m. micropterus* fairly common in the Rajpipla forests north of the Tapti river where we frequently heard them in June and

July. The earliest that we heard the *bo-ko-ta-ko* call of this bird is sometime in the first week of June. This is also the period during which SGM found nests (with eggs or nestlings) of *Terpsiphone paradisi, Dicrurus paradiseus, Dicrurus adsimilis* and *D. caerulescens*, and also of *Oriolus xanthornus*. These are reported to be the chief birds in whose nests putative eggs of *C. micropterus* are claimed to have been found (HANDBOOK, Vol. 3, Salim Ali & Ripley S. D.) It thus appears that *C. micropterus* is a rains (breeding?) visitor to the area, though it may occur during the other times of the year as well when it remains silent and is thus difficult to see. Here it may be stated that in the Borivli National Park in the neighbourhood of Bombay SGM when birding along with Kiran Srivastav saw a solitary *C. micropterus* on 24th October 1982. Little is known as regards the breeding of this cuckoo. In NIDIFICATION. vol. 3, Stuart Baker writes, "no information has been recorded as regards breeding of *C. micropterus*, except a possible connection with drongos and with *T. paradisi*. Rev. F. S. Briggs found this bird fairly numerous in the neighbourhood of Mhow, about 200 kms. NE of Rajpipla, in the Vindhya hills where he recorded them only in June and July (*JBNHS* 35:395).

C. E. Hewetson (*JBNHS* 53: 627) in 'Bird-life in MP' presumes *C. micropterus* to be a migrant in MP, present from March in south MP and from May in north MP, upto July or August. But he also considers that since this cuckoo is silent for the rest of the year, one fails to spot it. Osmaston found *C. micropterus* rare at Pachmarhi on the Satpuras in MP where he occasionally heard it in April and May (*JBNHS* 28: 457).

INDIAN BANDED BAY CUCKOO
(*Cuculus sonneratii*)

Suspected seeing this species around Piplod in June.

KOEL (*Eudynamys scolopacea*)

Often seen and heard, though uncommonly, in forest, and also at Dediapada and in Rajpipla town.

SMALL GREENBILLED MALKOHA
(*Rhopodytes viridirostris*)

On 11th June 1982, SGM while bathing in the rivulet behind Namgir was attracted by a harsh call. On locating the call, a greyish longtailed bird the size of a sirkeer cuckoo, was seen on the branch of a nearby tree. On focussing the binoculars it was observed that the bird had a very prominent green beak and was promptly identified as *R. viridirostris*. The lower body was somewhat paler coloured and the region of the breast was lightly streaked with much paler. Morever the long loose-looking tail was white-tipped and soon when the bird flew almost over SGM across into the forest, the white in the tail tips was very easy to see and very prominent too. S. D. Ripley in SYNOPSIS gives the range of this bird as peninsular India from Baroda (Gujarat), Maharashtra, Orissa and southwards to Kanyakumari.

In 'Birds of Gujarat' (Sálim Ali *JBNHS* 52: 435), there is mention of a sight record of *R. viridirostris* from Ajwa in Gujarat.

SIRKEER CUCKOO (*Taccocua leschenaultii*)

Seen along the road leading from Mozda towards Namgir and also behind Namgir in forest. The bird prefers to remain in dense scrub and low bushes. It was also seen in bamboo forest along the Samot road. Near

Rajpipla town a solitary bird was seen once, while we also came across a solitary bird near river Karjan a few miles from Rajpipla town.

SGM found this cuckoo breeding near Channi, Baroda in June, 1979. The nest was a somewhat weak looking flat construction of dry twigs and it was lined with a sufficient amount of leaves, both dry as well as fresh. The nest contained two very pale creamish-white eggs on 10th June when it was first found. The Sirkeer cuckoo can be easily recognized by its long graduated white tipped tail, its more brownish plumage and a very prominent slightly yellowtipped bright red beak.

CROW PHEASANT or COUCAL
(*Centropus sinensis*)

A common bird in the forests. Banga had found an occupied (with nestlings) nest in June. A bird was once seen carrying a lizard in its beak in late June. Seen also near Dediapada (near PWDRH compound and in the neighbourhood of the mission) and also in Rajpipla town. Seen also in the Juna-Rajpipla forests in January 1982. The birds are exceptionally noisy during the rains though they may also be heard throughout the year.

BARN OWL (*Tyto alba*)

The only occasion when we saw *T. alba* was on the afternoon of 10th June 1982. We were sitting in the PWD office at Dediapada when from almost overhead flew a very noisy procession of crows. They were mobbing and chasing a solitary Barn owl which settled in a large tree behind the ashram at Dediapada. Dediapada is teeming with several thousand Fruit Bats (*Pteropus giganteus*) and this particular tree was one of the many daytime roosts of these bats. Obviously the bats were greatly disturbed when the crows followed the owl into the tree. The next few minutes were fascinating, the crows, fruit bats (also known as flying foxes) and the culprit of the drama the owl settled somewhere in the tree. After sometime the crows began to disperse and even the bats quietened down but we do not think if we saw the owl fly away. We were informed that *T. alba* is occasionally seen in Rajpipla town. The only other time we saw a barn owl was in June 1981 at Chandod, just north of the Narmada river.

GREAT HORNED OWL
(*Bubo bubo*)

We often saw three large owls (with ear tufts) in the forest along a stream where the birds would remain hidden in a densely foliaged tree. Often due to our observing them during the day, these owls would fly away and then for the next few minutes they would be heavily mobbed by a great many avain denizens of the forest. While two of these large owls were identified as *B. b. bengalensis* (orange-yellow eyes and also the deep *huu..hooo* calls), the third owl appeared pale to us and we feel it was *B. c. coromandus* which SGM feels sure of having once heard during the night.

BROWN FISH OWL (*Bubo zeylonensis*)

Banga had informed us in the course of our first visit in June 1981 of a large owl which nested on the rock face along a forest rivulet. We saw this rather shabby nesting place where the owl had reportedly bred earlier in the year. The nest site was littered with crab shells and fish bones, evidently exposed from dried and old pellets. It was not until the 12th June 1982, that *B. zeylonensis* was first seen not far from this nest-site. According to Banga there existed another pair of these same owls upstream and which had another nest on a rock face.

BARRED JUNGLE OWLET (*Glaucidium radiatum*)

Certainly the commonest owl in the forests. Its *koukuk...kookok..kukkuk..* calls can frequently be heard during the daytime too and they happen to be one of the most familiar bird calls in these forests. The calls extend for several seconds and at times end abruptly.

On 20th July 1982, an adult Barred Owlet was noticed feeding (probably a large insect) to a young owlet outside what appeared to be the nesthole. The young owlet was uttering a mewing call.

BROWN HAWK-OWL (*Ninox scutulata*)

RKN says that he saw, on quite a few occasions a pair of these owls in the huge trees along the path leading to Namgir. We failed to come across this owl elsewhere and we never heard its uw...ook... calls anywhere either.

SPOTTED OWLET (*Athene brama*)

Though not common in the forest, this owl is abundant just north of the Narmada, at Chandod. Here we saw almost 4-8 at times even more of these owlets on almost every tree in the area. Chandod is one of the most fascinating places for observing this owlet in great numbers.

We frequently heard this owlet in Rajpipla town, often in crowded localities. In the forests Banga informed us that a pair of these owlets had bred earlier in the year in a hollow of the same tree on which, though in another hollow, a pair of *Coracias benghalensis* had also finished breeding in May. There was yet another pair of these owlets which, SGM feels were breeding in a tree in the compound of the PWDRH at Dediapada.

MOTTLED WOOD OWL (*Strix ocellata*)

First recorded when we heard these wierd *chuu..huwha* calls on successive nights at Namgir at around dusk and again during the night. It was only on 12th June that we first encountered *S. ocellata* deep in the forest, a few kilometers from Namgir. The dark eyes and the large head without the tufts was unmistakable. The owls were vocal in the late evening when we were observing them and these calls were identical to the ones we had heard the nights before. For atleast twenty minutes we watched the owls till it got quite dark and we had to return to Namgir.

NIGHTJAR

In a small scrub and dry grass covered hillock just on the southern banks (i.e. Rajpipla side) of the Narmada river, SGM often flushed a solitary Nightjar in the first two weeks of June 1981. The bird on flying from almost under his feet would settle further in the grass or on a flat rock from where it would crawl and remain in the fallen leaves. We never heard it call and could not identify it.

We failed to come across any nightjar in or around the forests. This is surprising since we never heard any either. But according to adivasis these birds are often flushed by them.

ALPINE SWIFT (*Apus melba*)

SGM has seen this bird around Daman Mahal, flying about around the cliffs. Not seen anywhere else.

HOUSE SWIFT (*Apus affinis*)

Seen at Netrang, Rajpipla town (sometimes large gatherings near the red clock-tower and often around the old houses) and also near Dediapada. Evidently breeding in May-June in Rajpipla town. Observed also at Chandod.

CRESTED TREE SWIFT (*Hemiprocne longipennis*)

RKN first saw this bird when photographing *S. cheela* from the hide in June 1982. On a later day SGM too saw this swift in more or less the same position as described by RKN. The solitary swift was perched as though it was incubating its single egg. But it was not there on any later day and there was certainly no nest.

LESSER PIED KINGFISHER (*Ceryle rudis*)

In January 1982, we saw a pair of these kingfishers on the Karjan river in the Juna-Rajpipla area. On the Narmada river this bird is not uncommon and on some days we saw as many as five of these kingfishers together, uttering their pleasant twittering calls as they fly. They are spectacular birds to watch, especially when they hover about twenty odd feet above water and dive into the water at an astonishing speed.

In July 1982 a solitary bird was seen near Dediapada near the mission.

SMALL OR COMMON KINGFISHER (*Alcedo atthis*)

A pair of these kingfishers were evidently breeding in a mudwall along the Mozda river as they were observed to leave a tunnel hole on several occasions. This kingfisher is often seen on forest streams but it is uncommon in the area. Seen also on the Karjan in the Juna-Rajpipla forests and in the vicinity of Rajpipla town and on the Narmada.

STORKBILLED KINGFISHER (*Pelargopsis capensis*)

Surprisingly we never saw this kingfisher which is supposed to be not uncommon in the forests here. But SGM feels that the loud *ke..kekeke..* call that can be sometimes heard in the forest could be of this bird.

WHITEBREASTED KINGFISHER (*Halcyon smyrnensis*)

Common. A nest with one egg was found in mid-May 1982 in a mudwall in forest, quite some distance from any forest stream. There was yet another nest-tunnel in a mudwall deep in the forest and this apparently contained nestlings since the adult birds were observed taking insects into the tunnel which on checking was found to be atleast three feet deep. This bird is seen almost along every stream in forest. Also seen in Dediapada and Rajpipla towns.

Found breeding at Chandod, just north of the Narmada where we found one nest which was a very open affair. It was almost a depression in a natural cavity on the ground, almost like a lark's nest and it contained four glossy white eggs. The incubating bird could be seen right in the open. Unfortunately this nest and the eggs in it were found destroyed just a few days later (mid-June 1981).

CHESTNUTHEADED BEE-EATER (*Merops leschenaulti*)

This bee-eater is found only from Ratnagiri southwards, and also from Dehra-Dun east to Bhutan, Arunachal Pradesh, Assam and in the Eastern Ghats. We came across a pair on the southern side of the Narmada river on 5th June 1981. A note regarding this sighting, the northernmost in Western India is in *JBNHS* 79: 669-70.

This bird is not included in Sálim Ali's notes on 'Birds of Gujarat'.

GREEN BEE-EATER (*Merops orientalis*)

Sometimes seen in the outskirts of forest. Not common. However, it is abundant north of the Narmada, at Chandod and elsewhere where large numbers of this bee-eater were breeding in June 1981. Seen also near and in Rajpipla town (where breeding in June) and on the Karjan river.

INDIAN ROLLER (*Coracias benghalensis*)

This bird is not mentioned for the area by Sálim Ali in 'Birds of Gujarat' *JBNHS* 52: 447), or, rather, no specimen has been collected in this area.

We found this bird not at all uncommon in the forest. Infact the noisy nature of this bird makes its calls one of the very familiar bird calls of these forests. There is always a bird or two nearby, if not calling harshly, then quietly perched on some dry branch from where it suddenly flies with a flash of its bright colours.

At one nesthole, the adult bird was observed feeding a young just outside on the branch in mid-June. A pair had finished breeding, according to Banga, in a cavity in the very same tree on the path leading to Namgir in forest which had also housed a pair of *Athene brama*. The nesting season of this bird appears to range between mid-March to June, July. We also saw *C. benghalensis* at Dediapada, and also near Rajpipla town where a pair was evidently breeding on a tree in the palace grounds in June 1981.

HOOPOE (*Upupa epops*)

We saw the Hoopoe only in January around the mission and the PWDRH at Dediapada. In June however, we have once seen a pair a few kilometres from Chandod. No information as regards breeding.

GREY HORNBILL (*Tockus birostris*)

The only time we have come across this bird is a pair seen by SGM and Neil Soares on 12th June 1982, several kilometres from Namgir inside the forest. We doubt if we ever heard the shrill squeals of this hornbill in these forests where it appears to be a uncommon bird.

LARGE GREEN BARBET (*Megalaima zeylanica*)

Though not so common, nevertheless the calls of this bird can be heard throughout the day. The *pukruk, pukruk* calls can never be mistaken if once heard and they are one of the most familiar bird calls in our forests. A bird was flushed from within a nesthole in June 1982. It returned into the hole soon after. S. D. Ripley in SYNOPSIS gives the range of *M. viridis* (785) as the Western Ghats, from the Narmada river south through Kerala. This bird can be distinguished from *M. zeylanica* only by its white cheek stripe. But since these birds are rather difficult to locate in the forest we never quite managed to get a good look at the head of one.

Sálim Ali failed to come across *M. viridis* anywhere else in Gujarat except in the Surat Dangs forests south of the Tapti river. In HANDBOOK vol. 4, by Sálim Ali & S. D. Ripley the range of *M. viridis* is given as Kerala north to Narmada river.

CRIMSONBREASTED BARBET/COPPERSMITH (*Megalaima haemacephala*)

This bird may be sometimes heard and seen in forest. It seems to have penetrated into the forest and we found it at Mozda, Namgir, Piplod and elsewhere too. Seen only occasionally around Dediapada where it is not common. We also found it in Rajpipla town at Chandod, north of the Narmada river we found young birds just out of the nesthole in the first week of June. The young birds lack the crimson. They have more greenish upperparts and head and pale yellowish belly region and throat, the former lightly streaked. We saw them being fed outside the nest.

GOLDENBACKED WOODPECKER (*Dinopium benghalense*)

Often seen, at times along the road from Dediapada to Mozda. Quite common and vocal in the forest. At Namgir a bird was flushed from its nesthole on 10th June. It was twice again flushed from the same hole and it appears that it was breeding. Neil Soares found a pair breeding in mid-May at Dediapada.

YELLOWFRONTED PIED/MAHRATTA WOODPECKER (*Picoides mahrattensis*)

A pair of these woodpeckers was seen often entering their nesthole in a 'Haldu' (*Adina cordifolia*) tree on 10th June 1982.

Seen also at Dediapada in the compound of the PWDRH. Found breeding north of the Narmada at Chandod, where we found three nestlings just out of the nest in mid-June 1981.

PYGMY WOODPECKER (*Picoides nanus*)

This tiny woodpecker, because of its small size and its somewhat secretive habits is a rather difficult bird to encounter in the forest. It certainly is one of the most hard-to-see birds. We have seen solitary birds only thrice. The birds keep to thin branches where they move about around the branch, not very high up. We saw this woodpecker at Piplod, along the Samot road and once on the eagle-nest tree near Namgir.

HEARTSPOTTED WOODPECKER (*Hemicircus canente*)

Our sighting of this bird north of the Tapti river in the Rajpipla forests on the Gujarat Satpuras extends the range of this woodpecker northwards by about 60 km, the previous northernmost point of this bird's distribution being Sonagadh in Navsari district, in the Dangs forests. In forest behind Namgir, we saw a pair of *H. canente* for three consecutive days after which they disappeared and we never came across them anywhere else.

Ripley, S. D. in SYNOPSIS mentions about a probable extension of *H. c. canente* into the Gujarat Satpuras.

BLACKBACKED WOODPECKER (*Chrysocolaptes festivus*)

We first saw this bird when Banga showed us a nesthole and not far was this woodpecker. There was a pair in the neighbourhood. We saw this woodpecker again near the ashram at Mozda. No signs of breeding.

INDIAN PITTA (*Pitta brachyura*)

We have occasionally seen this bird in forest, the last sighting being on 10th December 1982 when we saw a solitary bird. Neil Soares saw this bird several times in May 1982. At Chandod, just north of the Narmada, we found this bird building a nest in July.

Ernest Shull considers *P. b. brachyura* as breeding in the Dangs forests south of the Tapti (*JBNHS* 59:659).

We saw a solitary bird on 10th Dec., 1982 (SGM & Eric D'Cunha). However, Sálim Ali (*JBNHS* 52: 454) failed to come across *P. b. brachyura* during his Gujarat survey between August and mid-April. There distinctly appears to be some seasonal and local movements of *P. brachyura.*

BLACKBELLIED FINCH LARK (*Eremopterix grisea*)

Sometimes seen in small flocks around Dediapada and also on the outskirts of Rajpipla town where we also saw a small party in the palace grounds.

In the first two weeks of June 1981, there were hundreds and hundreds of this bird on the stony banks of the Narmada river, a few kilometres from Chandod. This was just before the commencement of the monsoon and it appears that there are local movements of *E. grisea,* resulting in the sudden appearance of large numbers of this lark in certain areas on some days and almost a complete absence a few days later. Here, on the banks of the Narmada we observed that the larks would always prefer to remain in the shade of stones and would fly only when almost trampled upon. There was no signs of their breeding either in June (when they were abundant) nor in December-January. SGM found this lark breeding in mid-June in the neighbourhood of Baroda and in October, December, March and April in and around Bombay. Even around Bombay SGM feels that there are great local movements of this lark and that normally very few of these larks are observed when they have been found breeding.

RUFOUSTAILED FINCH LARK (*Ammomanes phoenicurus*)

Occasionally seen around Dediapada and rarely on the Mozda riverbed. Common on the banks of the Narmada river though a small flock was noticed on the Karjan banks in the vicinity of Rajpipla town. The birds were breeding on the Narmada, as was apparent by their carrying food in their beaks. However, no actual nest was found.

EASTERN SKYLARK (*Alauda gulgula*)

Around Chandod, a few pairs of this lark were in song and it is possible that breeding was in progress in the neighbourhood. Not seen or heard elsewhere though it should occur in the vast open areas around Rajpipla town.

MALABAR CRESTED LARK (*Galerida malabarica*)

Around Chandod SGM has sometimes seen a solitary crested lark. It appears to be an uncommon bird in this area while around Rajpipla we altogether failed to come across any.

PLAIN SAND MARTIN (*Riparia paludicola*)

We feel (unfortunately we failed to confirm) that the good numbers of Martins flying about a huge mudwall immediately on the banks of the Narmada were Sand martins. The birds were evidently nesting on this mudwall on the Narmada, at Chandod.

DUSKY CRAG MARTIN (*Hirundo concolor*)

In June 1982, a pair of these martins were observed collecting wet mud from a roadside puddle near Mozda. On 22nd July a pair was busy in the construction of their nest on the underside of the bridge on the river along Samot road (about 1 km from Mozda). The pair were bringing in wet mud once every 10-15 minutes and the nest appeared to be almost fully built on that day. The nest is a lovely half-cup of mud and it was stuck to the perpendicular surface of the bridge wall, in an inaccessible position. The row of white spots at the tip of the tail of the martins was clearly visible as SGM was observing the martins from above as they would go to their nest under the bride. We also came across this martin at Chandod.

EASTERN SWALLOW (*Hirundo rustica*)

Seen in December and January around Dediapada, Netrang, Rajpipla town environs and also around the Narmada.

WIRETAILED SWALLOW (*Hirundo smithii*)

In June 1982 we noticed a small flock of about 8-10 birds flying along a small stream at Dediapada. Not seen elsewhere.

STRIATED (REDRUMPED) SWALLOW (*Hirundo daurica nipalensis*)

This, the migratory race of *H. daurica* is seen in very large flocks in winter. It also has a much paler rump than *H. d. erythropygia* which is the resident race here.

An enormous flock of swallows seen on the telegraph wires between Dediapada and Netrang in December 1982 was of this species. This particular flock occupied atleast a hundred metres of wire length and the birds would frequently launch aerial sallies.

STRIATED (REDRUMPED) SWALLOW (*Hirundo daurica erythropygia*)

Seen normally in small flocks or in twos and threes. We came across it near rock-faces upon Daman-mahal mountain (supposed to be the highest mountain in the area, being over 3000 ft. above m.s.l.) and once around a rocky riverbed near Namgir in forest.

Seen also near Dediapada, Rajpipla town and at Chandod where breeding was in progress in June.

BAYBACKED SHRIKE (*Lanius vittatus*)

Seen a few kilometres north of Chandod (North of Narmada river) in June when SGM feels that the birds (there was a pair) were breeding in the neighbourhood.

RUFOUSBACKED SHRIKE (*Lanius schach*)

Just norrth of the Narmada river we found atleast six nests of *L. schach*. The nests were found in July 1981. The nest of this bird is a massive looking cup, built of a great many materials and at times it even contains wool, rags and feathers. It is normally very well concealed in the fork of a thickly foliaged branch of a mango or a tamarind tree. Two of the nests we found were on thorny trees. All these nests were between 8-15 feet from the ground though one of them was much higher on a *Magnifera indica.* Only one of the nests had three eggs while the remaining contained five eggs each. The eggs are whitish or very pale pink, spotted with reddish brown and purple.

We feel that the birds which we found breeding north of the Narmada, at Chandod and Dabhoi should be *L. s. erythronotus* (i.e., The Rufousbacked Shrike). Atleast at three of these nests, the adult birds had much more rufous, distinctly somewhat brighter and also extending to the back, though not very easily observable. Sálim Ali in 'Birds of Gujarat' (*JBNHS* 52:781-82) has considered the Greybacked shrike (*L. s. caniceps*) in which he states, the rufous is more or less confined to the rump, though he also mentions that there is a regular cline and in a great many cases (especially in winter), it is exceedingly difficult to assure oneself of the correct racial identity of individual specimens. Sálim Ali regards *L. s. erythronotus* as a winter visitor to Gujarat, and the breeding birds, though clearly intermediate, are closer to and would readily pass for *caniceps.* This intermediate population was named by Koelz as *L. s. kathiawarensis* (now considered as *caniceps,* by S. D. Ripley in SYNOPSIS). We ourselves went through all the specimens in the BNHS collection, and we feel that there is not much to sufficiently differentiate *erythronotus* and *caniceps* in the field. Moreover, Capt. Butler *Stray Feathers,* iii: 463—1875) has considered *erythronotus* as the breeding (resident) race.

We occasionally came across this shrike south of the Narmada but we did not look for any nests here. In December and January we saw these shrikes around Rajpipla town and also in the vicinity of Dediapada, near the PWDRH and elsewhere.

GOLDEN ORIOLE (*Oriolus oriolus kundoo*)

Presumed to be a winter visitor to the area by Sálim Ali (*JBNHS* 52: 797). We however found this bird to be common and resident in Gujarat. SGM has found this oriole breeding in appreciable numbers around Baroda.

Just north of the Narmada river, at Chanddod, we found good numbers of nests of *O. o. kundoo.* In June-July 1981, we found several occupied nests of this bird. All of these had eggs and incubation was in progress. One of these nests was exceptionally low down, it being only about 8 feet from the ground on a tamarind tree, and SGM could touch the eggs (there were two) even when standing on the ground.

We saw this oriole occasionally south of the Narmada, at Dediapada and in and around Rajpipla town where this bird was certainly breeding in May-June. Noted also in the Juna-Rajpipla forests in January. We however, failed to come across the Golden oriole around Mozda or elsewhere in the forests.

BLACKHEADED ORIOLE
(*Oriolus xanthornus*)

Common in the forests. We never saw this bird anywhere around Dediapada though in January we observed it in Rajpipla town. Good numbers of this oriole were seen in the Juna-Rajpipla forests in January 1982. Breeding was in progress in June-July. We found two nests. One of these, found on 13th June 1982 contained two eggs while another containing three tiny nestlings was found in July 1982. Both these nests were well concealed in large leafy trees and while the former was only about 14-15 feet from the ground, the other was much higher.

BLACK DRONGO (*Dicrurus adsimilis*)

Very common around Rajpipla town, particularly in the open countryside and along the highways, where large numbers are always seen on overhead telegraph wires. Becomes progressively less common as one moves towards Dediapada and lesser still towards Mozda and the forests. Seen however in forest at Piplod (about 23 km from Dediapada) where a pair had a nest (evidently with eggs) in mid-June.

Nests were found in the vicinity of Rajpipla town in June, at Chandod where nest construction was in progress in July, and also near the PWDRH at Dediapada (with 3 eggs in last week of June), and one on way to Mozda on a teak (*Tectona grandis*) tree. All these nests contained two or three eggs while the nest in the PWDRH compound at Dediapada contained three tiny nestlings when next checked on 30th June 1981.

ASHY OR GREY DRONGO
(*Dicrurus leucophaeus*)

SGM and Eric D'Cunha saw this bird on 11th December, 1982. We found this bird present in good numbers in mid-Jan. 1983.

WHITEBELLIED DRONGO
(*Dicrurus caerulescens*)

Not uncommon in the forests. We saw it at Mozda, along Samot road, at Namgir, Piplod, Dumkhal, Juna-Rajpipla and elsewhere. A pair was calling incessantly in the compounds of the PWDRH at Dediapada on 13th June, 1982. Nests with eggs were found at Piplod and Namgir. In all we located four nests of *D. caerulescens,* three of them at Namgir and one at Piplod. Three eggs seems to be the normal clutch and the eggs are not much different from those of *D. adsimilis.* The nests of *D. caerulescens* do not appear to be so well concealed and all the nests found by us were between 12-25 feet from the ground, in the fork of an outhanging branch, almost all of these along a forest path.

GREATER RACKET-TAILED DRONGO (*Dicrurus paradiseus*)

A common and familiar bird of these forests, sometimes a few birds wander outside the forests and may be seen on roadside trees at Mozda, though we came across a small party of four birds at Moti-Singloti, several kilometres from Mozda towards Dediapada. Very common in the forest around Namgir where we were camping and seen almost everywhere in forest almost all the way upto Daman-mahal. One can never miss the much-varied and often confusing calls of this bird. Breeding was well under progress in June-July when we located five occupied nests, containing either eggs or nestlings. All these nests were very high on trees and two of them were on teak (*Tectona grandis*) trees. At two of the nests we observed that one of the incubating birds lacked both the tail streamers and appeared almost like a Black Drongo. At another nest both the adult birds had only one streamer each while at a fourth nest only one of the adult birds lacked a streamer. Only at one of the nests did the adult birds have both their streamers intact.

GREYHEADED MYNA (*Sturnus malabaricus*)

Sálim Ali altogether failed to come across this bird in Gujarat and this bird is not included in 'Birds of Gujarat' (*JBNHS* 52, Nos. 2, 3 & 4). We ourselves never saw this bird anywhere around Rajpipla but in December 1981 we noticed a flock of about thirty of these mynas near Timba, about 75 km north of Baroda. SGM has also seen this bird in the neighbourhood of Baroda where he feels a pair was breeding in a hole in a Jambool (*Syzygium cumini*) tree in June.

Himmatsinhji saw this bird in Kutch (Mandvi) in December 1969 and he also noticed a pair of these mynas busy carrying nesting materials in a hole in a casuarina tree at Wankaner in July 1967 (*JBNHS* 67:332-33). Capt. Butler found this bird common at Mt. Abu in the hot weather when he saw it in considerable flocks. He failed to observe this myna in the plains (*Stray Feathers* iii: 494-95).

BLACKHEADED OR BRAHMINY MYNA (*Sturnus pagodarum*)

Breeding in good enough numbers just north of the Narmada at Chandod where we found nests with eggs in June and July. Observed also in Rajpipla town (probably breeding) and also around Dediapada. We found this myna to be less common south of the Narmada towards Rajpipla.

ROSY PASTOR (*Sturnus roseus*)

Observed in January in Rajpipla town and also near Juna-Rajpipla. Seen in considerable flocks at Timba in December 1981. In December 1982, a few pastors were noticed near Mozda. Appears to be a rather common winter visitor.

PIED MYNA (*Sturnus contra*)

This bird does not deserve mention in this list. But since SGM has noticed a pair of these mynas at Valsad in November 1981, and since this bird has never previously been recorded in Gujarat we therefore include it. The Pied Myna is basically a bird of northern and eastern India, not ordinarily found west of Hyderabad in Deccan or south of Masulipatam. It is possible that this bird may have been an escaped cage-bird.

COMMON MYNA (*Acridotheres tristis*)

Though a common in the towns, we often saw this bird in the forests too. The birds were evidently breeding during May-July when they were very noisy and were seen entering holes in walls and trees. We however, never checked any nest either in the forests or around Rajpipla town but found nests with eggs in July at Chandod and SGM obtained eggs in May near Baroda. Four or five glossy pale blue eggs form the normal clutch. On the underside of a road bridge in Rajpipla town, large numbers of *A. ginginianus* along with *A. tristis* were certainly breeding in the many holes in the bridge walls in June.

BANK MYNA (*Acridotheres ginginianus*)

Breeding in abundance in the mudwalls of the many ravine-like formations in the immediate vicinity of Narmada river, around Chandod. Dozens and dozens of these mynas would fly from these mudwalls which appeared almost lifeless at first sight. But in these often inaccessible mudwalls there are countless holes (tunnels) of varying length, each of them having a haphazardly constructed cuplike mass of grasses and feathers inside and these contained eggs in mid-June. SGM on checking these nesting colonies found that some of these nests which had separate entrance holes were actually continuous inside. We are still surprised as to how, on somebody's approach, do all the birds from a widespread colony leave their nests together? How do these birds communicate at some approaching disturbance which pulls them all out of their nest holes at the same time? SGM similarly checked a large crowded colony of Little Green Bee-eaters breeding just a few kilometres north of Baroda and even here he observed that if he as much as approached the nesting colony very close, all the bee-eaters would immediately leave their nest holes and while some of them would circle overhead uttering their twittering notes, most of them would perch silently on the wires overhead and return back to their nest-tunnels as soon as the disturbance had ceased. At the nesting colonies of the Bank Mynas we however noticed that on our approach a few birds which would be outside would utter a harsh note and we feel that perhaps this harsh note of these outside birds is some kind of a warning call for the other birds inside their tunnels which at times are over four to five feet long. Probably at such nesting colonies where a large numbers of birds breed in close proximity, there are a few watch-birds whose harsh calls apparently serve as a warning signal for the other birds inside their nests.

JUNGLE MYNA (*Acridotheres fuscus*)

When observing *Spilornis cheela* at its nest from the hide, SGM noticed a Common-Myna like bird settle on the very tree, about ten feet from the hide. This bird lacked the yellow around its eyes and moreover it had a darker (somewhat greyish-black) and not yellow iris. Also, the ill-formed tuft of feathers on the head was very prominent. RKN too says that he noticed this myna from the hide when photographing *S. cheela*. There is no mention of this bird in 'Birds of Gujarat' (*JBNHS* 52), Sálim Ali having failed to find this myna in Gujarat.

S. D. Ripley in SYNOPSIS gives the range of this race as Peninsular India, chiefly on the western side, from Gujarat, including the Kathiawar peninsula, southwards through western Maharashtra to Kerala and Tamil Nadu.

INDIAN TREE PIE (*Dendrocitta vagabunda*)

Common in the forests. Breeding evidently over earlier in the year, probably by mid-May, though near one nest the parents were observed feeding two fledglings on 10th June. One of the common birds here, the tree-pie was never seen outside the forests and only once have we noticed a pair of these birds along the road at Bal, about a kilometre from Mozda.

HOUSE CROW (*Corvus splendens*)

Common in Rajpipla town and at Dediapada and in all the nearby towns. Almost absent around Mozda and further into the forests where *C. macrorhynchos* is more common. Some *C. splendens* may be however, seen at Mozda and even around Piplod and Dumkhal, and also once around Juna-Rajpipla. Nest-building observed in Rajpipla town in June-July when at a few roadside nests incubation was in progress.

JUNGLE CROW (*Corvus macrorhynchos*)

From Dediapada onwards towards Mozda and in the forests this is the crow that one is more likely to encounter. The House Crow is almost absent in the forests except for an occasional bird. At only one nest did we observe *C. macrorhynchos* in Dediapada town in June, 1981. It appears that this nest contained nestlings in June which is well past the recorded breeding season of this crow which normally nests early in the year.

COMMON WOOD SHRIKE (*Tephrodornis pondicerianus*)

Sometimes seen and heard in the light forest and scrub around Mozda. We also saw this bird in several other areas in the forests and also in bamboo forest along Samot road. This small shrike distinctly appears to prefer light open forest than thick forest. We also observed this bird around the PWDRH and the mission at Dediapada and on the outskirts of Rajpipla town we once saw three birds. No signs of any breeding activity in May or June, the birds probably having nested earlier in the year. However, SGM found this shrike breeding in the first week of June on the outskirts of Baroda when he found a nest with two almost full-fledged young birds in it.

LARGE CUCKOO SHRIKE (*Coracina novaehollandiae*)

Sometimes seen in the forests. In June and July we noticed that over half dozen of these birds would roost every night in a large 'Haldu' (*Adina cordifolia*) tree hardly 200 metres from our camp-hut in Namgir. Every evening at around 6-30 p.m. the birds would arrive and for the next half an hour or so till it was quite dark, the birds would be chasing one another, frequently uttering their pleasant musical notes. SGM is sure that he saw this bird several times passing some food (an insect) to another bird, probably its mate. He feels that what he saw was some pair-formation activity and that the breeding season of this bird was approaching.

LITTLE MINIVET (*Pericrocotus cinnamomeus*)

A well distributed bird in these forests. It is also the only minivet we came across in the Rajpipla area. Seen almost throughout the forests and also around the PWDRH at Dediapada and in the neighbourhood of Rajpipla town. We also saw unusually large congregations of this bird in January in the forest around Juna-Rajpipla.

In mid-June 1982, when walking along the road leading towards Namgir, SGM often observed this bird fly from a particular tree whenever he would pass under it. Careful searching for the next couple of days resulted in his locating the tiny nest, remarkably concealed on the upper surface of a tiny fork, just jutting out of the main stem, about 25 feet from the ground. In fact, had it not been for the apparent uneasiness of the birds on being observed from below, it would have been ratther difficult to spot the nest. When the female settled in the nest, her tail could be seen just protruding enough to be quite clearly noticed. There were certainly eggs in the nest and incubation was in progress, but since it had been raining for the past few days and the tree-trunk being wet and slippery, we could not risk anyone climbing up to have a look at the nest.

COMMON IORA (*Aegithina tiphia*)

A common bird throughout the forests, seen also at Dediapada and in Rajpipla town and also often around Chandod where it was observed breeding in July.

In the forests we found two nests of this bird. From one of these the young had apparently flown away in mid-June while the other contained two nestlings on 13th June. North of the Narmada *A. tiphia* was noticed building a nest in July. Around Bombay SGM has found nests with eggs in May, August and also in the third week of September. Probably *A. tiphia* breeds twice in a year.

GOLDMANTLED CHLOROPSIS (*Chloropsis cochinchinensis*)

Quite common in the forests. This bird is a fantastic mimic and we heard it reproduce to perfection the calls of *D. adsimilis, D. caerulescens, O. sutorius,* and to a lesser extent the calls of *P. jocosus, A. badius, Pomatorhinus horsfieldii* and also the harsh chew call of *T. paradisi.* We first observed this bird's amazing proficiency at mimickry at Piplod on our very first day in these forests on 18th June 1981. A pair of these chloropsis were mimicking and frequently chasing drongos (*D. adsimilis* and *D. caerulescens*), tree-pies, common mynas and also parakeets from a large tree where the pair was almost always present. On observing this highly demonstrative behaviour of the pair, we strongly suspected the presence of a nest there and surely enough there was one in the fork of a very thin out-hanging branch, almost 25-30 feet up in the tree. On 19th June, a bird was sitting inside the nest (probably incubating). The nest is a cup of grasses, fibres etc., and is quite like the nest of *P. cafer,* though we feel not quite as deep as that of the latter.

On 1st July morning a chloropsis was seen carrying food in its beak in forest near Namgir.

REDWHISKERED BULBUL (*Pycnonotus jocosus* ssp?)

In SYNOPSIS.... by S. D. Ripley, there is no mention of the presence of any race of this bulbul in the Rajpipla area between the Tapti and Narmada rivers. Sálim Ali during his Gujarat Ornithological survey (Birds of Gujarat —*JBNHS* 52:744) observed only a single pair at Waghai south of the Tapti in the Surat Dangs. He failed to meet this bulbul elsewhere in Gujarat, Saurashtra or Kutch.

We found *P. jocosus* present in appreciably good numbers north of the Tapti river in the Rajpipla area. Infact we once saw this bird at Dediapada too. In the forests SGM found a nest of this bird in a small bush on 10th June when it contained two nestlings. This was quite close to the nest of *S. cheela* which was photographed.

The occurrence of *P. jocosus* is discontinuous in Central India (C. E. Hewetson, in 'Bird Life in MP *JBNHS* 53: 606). Also, there is no mention of this bulbul for Mhow (Rev. F. S. Briggs *JBNHS* 35). However, at Pachmarhi in the MP Satpuras, B. B. Osmaston found this bulbul common in the ravines around Pachmarhi where he found them breeding in April-July (*JBNHS* 28:454).

REDVENTED BULBUL (*Pycnonotus cafer*)

Common everywhere. Several nests with eggs were found in May-July. Only one nest at Mozda contained full fledged nestlings on 13th June.

WHITEBROWED BULBUL (*Pycnonotus luteolus*)

Though the rambling calls suddenly burst from dense undergrowth almost anywhere in forest, the birds themselves are only rarely seen. We saw this bulbul only at Mozda and twice along the Samot road, and once in Rajpipla town.

At Chandod, just north of the Narmada this bulbul was found breeding in June and July when we found two nests. One of these had two eggs while the other contained two nestlings which, after a few days, had come out of the nest and we could often see the parents feeding these young birds on nearby trees. Though the nest of *P. luteolus* is rather similar to that of the other bulbuls, it certainly is somewhat untidier and weak-looking and is normally placed in open dry bushes or around a bush which is surrounded by some dry vegetation. The nest is generally situated under three feet from the ground and the adult birds get very restless when their nest is approached.

SPOTTED BABBLER (*Pellorneum ruficeps*)

This is one of the many forest-birds which are extremely difficult to spot but are not infrequently heard. The lovely whistling calls of this babbler are a quite common bird-call in these forests during the rains when they are breeding.

On 21st 1982, SGM found a nest of this babbler in heavy bamboo forest in the neighbourhood of Namgir. The frequent calling of the birds and their very peculiar behaviour was an asset to locate the nest. The nest itself was a roundish structure, atleast 6-7 inches in diameter and it was built of thin, and also, thick grasses, bamboo leaves and dry leaves. It was placed on the forest floor in damp bamboo forest and it appeared like a small heap of rubbish, superbly hidden on the ground. It may be mentioned here, that just a few days ago SGM had found a nest of this bird in the Borivli park, near Bombay. This nest was equally untidy and shabby, though somewhat smaller.

SLATYHEADED SCIMITAR BABBLER (*Pomatorhinus horsfieldii*)

On 23rd January 1983, when walking on the Daman Mahal mountain we heard these lovely musical two note whistles which were being replied to by another bird. These 'reply' whistles were followed by a harsh kharrrrr of a somewhat extended duration. The calls continued for a rather long time and we decided to check the producers of these calls. This was in a luxuriant bamboo forest and we slowly approached the flute-like notes. We decided to wait on a fallen tree-trunk from where we could obtain glimpses of two or three birds which were chasing one another and frequently diving into the bamboo growth. After a few minutes the calls increased to four notes and these SGM readily recognized as the calls of *Pomatorhinus horsfieldii* which he has so often heard around Bombay. It was but only after a considerable period of time that we managed to get a good view of the birds. There were three of them and it appears they were getting ready to breed. SGM similarly noticed great activity of this babbler around Bombay in the second week of January and he feels that *P. horsfieldii* breeds in the neighbourhood of Bombay (where, by virtue of its calls it happens to be a relatively common bird) during February-April. In the Dangs forests, south of the Tapti river juvenile birds were collected on 14th March (Sálim Ali, *JBNHS* 52:751). This happens to be the only occasion that we ever saw the Scimitar Babbler in the Rajpipla forests, though it may be heard more often.

WHITETHROATED BABBLER
(*Dumetia hyperythra*)

On 21st July 1982, SGM found a nest of this babbler in close proximity to that of *Pellorneum ruficeps* also located on the same day. There are some amazing similarities in the nests of *D. hyperythra* and *P. ruficeps.* Both the nests were more or less ball shaped structures placed on the ground in damp bamboo forest. Both nests were on gently sloping hills with their entrance holes facing downwards so that when the birds would fly from their nest, they would fly straight downhill and then perch on some small bush. Both nests were less than ten feet distance from much used forest paths. However, it may be stated that the nest of *D. hyperythra* was much more difficult to spot. This nest was a small ball of thick, coarse bamboo leaves with an inside cup of thin fibrous grasses and also a few hair. There was an oval entrance hole on one side, facing downhill. The entire ball-nest was about four inches in diameter and it was sort of anchored between two small stones at the base of a bamboo clump, an inch or so above the ground. But the most interesting part of this nest was a fallen large leaf of *Tectona grandis* which had been actually fixed into the sides of the nest in a most artistic manner. Many such large leaves of Teak were scattered on the forest floor and the use of one such leaf into the nest was undoubtedly a remarkable attempt at both camouflage as well as shelter. This leaf formed an efficient umbrella over the nest. While the leaf covering the nest was wet due to rain, the nest proper and the inside cup were completely dry. Moreover, the leaf covering the nest made it all the more difficult to locate the nest. There were three eggs in the nest on 21st July. The eggs had a very pale pinkish white ground colour and were rather thickly spotted and blotched with pale purple and reddish-brown. They were smaller in size than eggs of the House Sparrow.

YELLOWEYED BABBLER
(*Chrysomma sinense*)

Sometimes seen around the PWDRH at Dediapada and also around Rajpipla town and near the Karjan river. Occasionally seen in forest along Samot road and once in July a party of three birds was seen on the Mozda riverbed, flitting in and out of the vegetation. Frequently the birds would utter a pleasant warbling song from some exposed position. A search for nests did not yield any and it appears that the birds were evidently commencing to breed.

However, north of the Narmada river, at Chandod and also around Wadhwana tank at Dabhoi we located several nests in July 1981. Most of these nests were under construction though one of them contained two eggs in the second week of July. The egg is thickly spotted and blotched with pale brownish-red and also some purplish shade. The ground colour of the eggs was pale pinkish-cream. Some of these nests were in thorny bushes and trees.

COMMON BABBLER (*Turdoides caudatus*)

Found breeding at Chandod where we located two nests in June-July 1981. Both the nests were in dense thorny scrub and while one of them was being built on 8th June (but later destroyed by a village boy), the other contained three eggs on 11th July. The nests can be likened to nests of *Pycnonotus cafer* though somewhat more deep and more loosely made and lacking any cobweb. The eggs are a lovely shade of glossy blue and are more or less the same size as eggs of *P. cafer.* The birds distinctly prefer scrub covered areas where they are normally seen in small parties of 4-6 birds. At Channi, on the outskirts of Baroda, SGM noticed in July 1979, a pair of *Clamator jacobinus* not far from the nest of *T. caudatus.* In the first week of July when the nest contained two eggs, a solitary cuckoo was seen to enter the bush which contained the nest. It was driven away by the babblers but it continued to go there after about twenty minutes. SGM feels that the cuckoo had probably laid its egg in the babbler's nest.

LARGE GREY BABBLER (*Turdoides malcolmi*)

This babbler is a common bird in the open and scrub countryside here. The bird is always seen in small parties which it appears do not break up even during the breeding season. We observed this babbler carrying nesting material in July. Though no actually occupied nest of this babbler was found, it appears that they breed sometime between May-August. This babbler is one of the few which is selected as a foster parent by the Pied Crested Cuckoo (*Clamator jacobinus*) of which we saw a few examples only in mid-July in the forests.

About *T. malcolmi* we may add that it happens to be one of the most gregarious species of birds. On 12th June 1982, three birds were seen in open country a few kilometres from Dediapada towards Mozda and found breeding at Chandod.

JUNGLE BABBLER (*Turdoides striatus*)

We did not come across any rufous-tailed race (*T. s. somervillei*) in the Rajpipla area.

In its habits we would like to state that it is not appreciably different in any respect from *T. malcolmi.* However *T. striatus* is certainly a more common bird in the forest area. A few of these birds can be seen on almost every outing in the forests. A nest containing two nestlings was found at Chandod, just north of the Narmada river in mid-June 1981. The nest is a rather loosely put together cup of grass stems, small bent sticks including a few thorny sticks. It is normally built in some thorny bush or tree, generally under eight feet from the ground in a fork, preferably one just jutting out of the main stem. Little, if any atempt is made at concealing the nest and infact the noisy nature of the birds makes it all the more easier to locate the nest. Even around a nest containing nestlings, small parties of this babbler move about and it would not be surprising if other babblers, besides the parents, feed the nestlings too. Infact on the very tree which contained a nest of *T. striatus,* SGM saw on two occasions *T. malcolmi* and the former did not seem to mind this intrusion at all.

On 21st July 1982, Jungle Babblers were observed making nests in the forests along Samot road where SGM saw them carrying grass and thin sticks. On this very day he also noticed great activity among *Clamator jacobinus,* of which the Jungle Babbler is a much sought after foster parent.

BROWN FLYCATCHER (*Muscicapa latirostris*)

SGM and Eric D'Cunha saw this bird in December 1982. There was a solitary bird. Probably this flycatcher should be more common here but because of its silent nature and its dull coloration coupled with its small size, it is a difficult bird to be seen in the forest. Sálim Ali came across this bird only in the Dangs area south of the Tapti where he presumes the birds to be resident (*JBNHS* 52: 746).

REDBREASTED FLYCATCHER (*Muscicapa parva*)

This flycatcher is a common cold weather migrant to these forests. It can be seen everywhere in the forests and we saw one almost at the top of Daman-mahal mountain. Seen at Dediapada and in Rajpipla town and around Juna-Rajpipla forests in December-January. The birds prefer the shaded patches of forests and their faint *clikrrr*... and *tttrrrr*....notes are commonly heard in the forests. Often one may come across this bird in a small mixed group of forest birds.

TICKELL'S BLUE FLYCATCHER (*Muscicapa tickelliae*)

Certainly the commonest resident flycatcher in these forests. Seen in almost every kind of forest, the bird having a marked preference for dense bamboo growths. Seen throughout the forests at Piplod, Dumkhal, Sankhdi, Namgir, Samot road, Mozda, Juna-Rajpipla and elsewhere. Observed also in the neighbourhood of Rajpipla town and a pair was frequently seen in the vicinity of dense undergrowth of the garden of the hotel we were staying in at Chadod, north of the Narmada. Here the pair was busy constructing its nest in a hole in a mud-wall around a bamboo bush in mid-June.

On 12th June 1982, a nest of this flycatcher was found in a small hollow of a tree in forest near Namgir. The nest was a well-made pad of fine grasses and a few scattered feathers. It contained a single brownish white egg, spotted lightly with reddish-brown. This bird frequently utters a pleasant short song, somewhat metallic in tone and this we heard even in December. Besides this song, the bird also has a harsher clicking and churring note which SGM heard while he was inspecting the nest of this flycatcher.

GREYHEADED FLYCATCHER (*Culicicapa ceylonensis*)

Sálim Ali during his Gujarat Ornithological survey came across this bird only in Cambay and at Hathidhara (Palanpur) and he presumed this bird to be a not common winter visitor (*JBNHS* 52:747-48).

In January 1982, we observed a few examples of *Culicicapa ceylonensis* in the forests around Juna-Rajpipla. In June 1982, a solitary bird was seen around the forest stream at Namgir for several consecutive days. This particular bird seen in June had a peculiar habit of fly-catching over the stagnant water that had collected on the otherwise almost dry bed of the stream. The bird would remain motionless on a fallen log just over the accumulated stagnant puddle around and over which there was always to be seen a fantastic number and array of mosquitoes and various small insects and beetles. Every few minutes the bird would swoop down almost touching the water on every such swoop and always there could be heard a sharp snap of its mandibles as the countless insects would be disturbed. For several days we observed this flycatcher at this puddle but we never saw it again after 11th June. Often the bird allowed our very close approach.

It was however in December 1982 that we found *C. ceylonensis* extremely common in the forests around Namgir and elsewhere. In three days SGM and Eric D'Cunha had 27 sightings of this flycatcher. Sometimes the bird would utter shrill, musical calls of 4-7 notes. Again in January 1983, we found this bird fairly common here.

We never obtained any signs of this flycatcher breeding in the Rajpipla forests. This bird is a common resident species in the central Satpuras (S. D. Ripley in SYNOPSIS). In 'Bird Life in MP' (*JBNHS* 53:609), C. E. Hewetson considers this flycatcher as one of the commonest and most widely spread small resident birds. B. B. Osmaston found this bird common in the ravines in and around Pachmarhi in the central Satpuras where he states they breed in June-July (*JBNHS* 28:455).

Our observing this flycatcher in such good numbers in December-January would probably support Sálim Ali's presumptions that *C. ceylonensis* is a winter visitor to Gujarat (Satpuras), but we feel that a few birds presumably breed in the Rajpipla area at the western extremity of the Satpuras.

WHITEBROWED FANTAIL FLYCATCHER
(*Rhipidura aureola*)

First seen in January 1983 in open forest in the neighbourhood of the Karjan Dam (under construction). We then saw this flycatcher on three occasions in forest around Namgir.

WHITETHROATED FANTAIL FLYCATCHER
(*Rhipidura albicollis*)

Seen in forest around Namgir and once also along the Samot road. In December we saw it in the Juna-Rajpipla area and in the neighbourhood of Rajpipla town. Nowhere, a common bird. No indication of its breeding.

PARADISE FLYCATCHER
(*Terpsiphone paradisi*)

On 19th June 1981, SGM found a nest of this flycatcher in a small creeper-bound tree along the Mozda river near Sankhdi. About ten feet from the ground, the nest was in such a position that if the creeper was pulled then there was every possibility of the nest being damaged. This fear almost compelled SGM to collect the nest and its contents. Only half an hour later when SGM again went to check the nest there was no sign of the nest on the tree. It was not long before the cause of this mishap was brought to light and the nest and its contents (surprisingly an intact egg alongwith smashed eggshells) were found and collected from the ground nearby. It so appears that some adivasi kids who had been playing around when the nest had been first located had pulled the branch with a jerk so that it had almost broken off and the nest thrown out. From the condition of the yolk of the smashed eggs in the nest it seemed as though the eggs were almost on the verge of hatching. The solitary egg was collected by SGM and is presently in his collection in Bombay. It is pale creamish-pink in ground colour, lightly spotted and blotched with reddish-brown. It is almost an exact, though miniature, replica of the eggs of *Dicrurus adsimilis.* The nest was not collected as its inside had been spoilt by the spilled contents of the smashed eggs.

Not far from this spot (almost opposite Sankhdi) a male Paradise flycatcher in white adult plumage was seen. Nearby were two females. In January we came across this bird around Juna-Rajpipla while in December 1982 and in January 1983, we found this bird rather common in the forests. In May-June we completely failed to come across this bird anywhere in the forests, but in July SGM noticed a female in the forest not far from Namgir.

Sálim Ali (*JBNHS* 52:750) hazards a guess that *T. p. paradisi* breeds in Rajpipla and in the Dangs. Further, he states that *T. p. leucogaster* is purely a winter visitor and a passage migrant in this area. As such, it cannot be completely ruled out that the good numbers of *T. paradisi* that we saw in Dec.-Jan. in these forests probably consist of both *T. p. paradisi* and also *T. p. leucogaster*, a few *T. p. paradisi* remaining here to breed. This bird has also been reported to breed in the Gir Forest of Junagadh by K. S. Dharmakumarsinhji (*JBNHS* 48:188).

The status of *T. paradisi* appears to vary from one locality to another (Sálim Ali: 'Birds of Gujarat' *JBNHS* 52:750).

B. B. Osmaston (*JBNHS* 28:455) stated that some birds breed around Pachmarhi in the central Satpuras while Rev. F. S. Briggs presumed this flycatcher to be resident around Mhow (*JBNHS* 35:386). C. E. Hewetson (*JBNHS* 53:609) in 'Bird Life in MP' regarded *T. paradisi* as a summer migrant in MP, arriving in the last week of March and common till the rains break when many birds move on and a few nesting birds probably staying throughout the rains. He also writes that the number of birds vary from year to year.

BLACKNAPED FLYCATCHER
(*Hypothymis azurea*)

Writing of this flycatcher, Sálim Ali found it one of the commonest birds in the bamboo, teak and mixed deciduous forests here. He probably found it so in the Surat Dangs (*JBNHS* 52:749-50). In the Rajpipla area, north of the Tapti and the Dangs, we would hesitate to regard this as one of the five commonest birds in these forests.

We saw this bird only on a few occasions in the bamboo forest around Namgir and in forest along the Mozda-Namgir and Mozda-Samot roads. Along the Namgir road a pair was apparently breeding in the second week of June, though we did not find the nest. A male in very bright plumage was also once seen near Piplod. It remained around a bamboo clump for a few minutes and then with a sharp call it vanished like a gem into the dark and deep of the forest. The breeding season here should range between June-August.

STREAKED FANTAIL WARBLER
(*Cisticola juncidis*)

In July, 1982, when good rains had encouraged a growth of grass and vegetation around the Mozda river and also around Dediapada, the *chik..chik...* calls of *C. juncidis* could often be heard. We observed a few of these warblers displaying in the air and calling incessantly, their shap *chik..chik..* calls carrying for a good distance. Undoubtedly, the birds were either breeding or were getting ready to do so. Also in the same month, a pair of these warblers were noticed to be very active and noisy in a grass covered forest clearing, near Namgir. In January 1983, we noticed this warbler on the Karjan river, about 10 km from Rajpipla town.

FRANKLIN'S WREN WARBLER
(*Prinia hodgsonii*)

A solitary bird in breeding plumage, with the dark breast band, was observed in July 1982 in cultivation around Mozda. The bird was noisy and was probably breeding. Near Baroda SGM noticed this bird commence nest-building in the second week of June while he has found several nests with eggs and/or nestlings in July and August in and around Bombay.

PLAIN OR TAWNYFLANKED WREN WARBLER (*Prinia subflava*)

Seen around Dediapada (PWDRH) in July and near Chandod, north of the Narmada. Not a common bird. The birds were certainly breeding around the PWDRH at Dediapada, in the long grass and scrub in July. A couple of pairs were engaged in a series of sharp trilling notes and when the bird flies it sometimes produces a sharp snapping noise.

ASHY WREN WARBLER (*Prinia socialis*)

This is basically a bird of open country but it has also penetrated the forests in small numbers. We found two nests in the forests, one of them around Namgir and the other not far from Mozda in June when it was under construction. The nest found near Namgir contained two eggs on 10th June 1982. Both these nests were under four feet from the ground and while one of them was contructed in one large leaf, three leaves were utilised in the nest near Namgir. This nest was a rather deep cup among the three leaves which had been sewn together.

We also saw this warbler elsewhere between Mozda and Dediapada, at Juna-Rajpipla, along the Karjan river, around Rajpipla town and also at Chandod, north of the Narmada where a pair was building its nest about eight feet high among the leaves of a tree.

JUNGLE WREN WARBLER (*Prinia sylvatica*)

Occasionally seen in the outskirts of forest, particularly around grass-covered stony localities in the vicinity of some stream. In July a solitary bird was seen near Namgir in forest. Seen also around the PWDRH at Dediapada.

TAILOR BIRD (*Orthotomus sutorius*)

Certainly the commonest warbler here. Good numbers of this bird have reached into the forest and it was not at all surprising to hear a couple of these warblers almost at 3000 feet on Daman mahal mountain, quite a distance from any human habitation. This bird may be seen and heard in many other places in the forest, its loud *towit, towit....* call being a rather commonly heard birdcall here. Several nests were found in the forest in June and July. Banga found one with four eggs in a small bush in July. Nests in various stages of construction were also located along the Mozda-Namgir road. Also seen around the PWDRH at Dediapada and at Rajpipla town where it is more of a common garden bird. Construction was under way at Chandod in the second week of July.

ORPHEAN WARBLER (*Sylvia hortensis*)

A winter visitor. Not common. Infact we have seen this largish warbler only twice in January, in light scrub forest around Juna-Rajpipla, and once in the vicinity of Rajpipla town near the Karjan.

LESSER WHITETHROAT (*Sylvia curruca*)

Seen very clearly only once near the PWDRH at Dediapada in December. (The Leaf-warblers are not at all common in the Rajpipla area. Atleast we did not find them so. We observed only three different kinds of them, two of them around Rajpipla and Dediapada, and only one in the forest. Due to uncertainty in their field identification, we do not wish to comment any more on the genus *Phylloscopus*).

BLUETHROAT (*Erithacus svecicus*)

We first saw the Bluethroat (a solitary red-spotted male) along the river, hopping amongst the stones and scant vegetation at Juna-Rajpipla. A few days later, we again saw the bird nearby.

In December 1982, Eric D'Cunha and SGM saw a male *E. svecicus* twice along a forest stream at Namgir. One of these males was in very bright plumage, the red spot being bright and prominent.

This bird happens to be an uncommon winter visitor to this area.

MAGPIE ROBIN OR DHYAL (*Copsychus saularis*)

Often seen in the forests at Mozda, Namgir, Piplod, Dumkhal etc., and we also saw it in January in the Juna-Rajpipla forests. This graceful bird can also be sometimes seen in gardens in Rajpipla town. We also saw it around Dediapada, where a nest with three eggs was found near the PWDRH. At Namgir we located two nests of this robin. One of these had three nestlings on 24th June, while the other contained two full fledged nestlings on 21st July. On 19th June a nest containing two eggs was found in the hollow of a very big tree at Piplod. We also found this bird breeding north of the Narmada river, at Chandod, where we had a nest containing five eggs destroyed by a village kid. Birds are in song at this time of the year, though the *sweeee.... sweeee....* call can often be heard during the winter months too.

SHAMA (*Copsychus malabaricus*)

On 11th June 1982, a solitary *C. malabaricus* was noticed in a semi-evergreen patch of forest, several kilometres from the Mozda road. This happens to be our only sighting of this bird in the Rajpipla area, north of the Tapti river. The previous northernmost recorded distribution of this bird is from the Surat Dangs forests, about 100 kms south of the present sighting (*JBNHS* 52:769). As such there seems to have been a northward extension of this bird.

S. D. Ripley in SYNOPSIS gives the range of *C. m. malabaricus* as "The western Indian peninsula from Surat Dangs south along the Western Ghats." The range of *C. m. indicus* is given as "Himalayan foothills and plains from Kumaon through Bhutan, eastern India and Bangladesh south to Chittagong, and again from Bihar (Rajmahal Hills) south through eastern MP (Chanda, Balaghat, Raipur, Bastar) and the Eastern Ghats to the Cauvery river."

BLACK REDSTART (*Phoenicurus ochruros*)

A winter visitor. Not common. In December and January this bird was seen at Juna-Rajpipla, Dediapada, Rajpipla town and in several other places.

STONE CHAT (*Saxicola torquata*)

A common winter visitor to the area. The bird prefers open country and in December-January we often came across this bird around the PWDRH at Dediapada and also around Rajpipla town.

PIED BUSH CHAT (*Saxicola caprata*)

We found this bird breeding in the vicinty of Narmada river at Chandod. In the second week of June 1981, SGM found a nest of this bird containing two eggs. The nest was in a hole in a mudwall flanking a much used path leading to the Narmada river. The nest was a roughly built pad of fine grasses and a good amount of hair. Unfortunately this nest was destroyed by some village boys.

DESERT WHEATEAR (*Oenanthe deserti*)

An uncommon winter visitor. We saw this bird only twice in December and in January several miles from Dediapada and once near the Karjan river. Not seen anywhere else.

INDIAN ROBIN (*Saxicoloides fulicata*)

A common bird in the dry open countryside around Dediapada and around Rajpipla town. We found a good number of nests of this bird. On 12th June, a nest with two nestlings was located along the road in a mudwall, a couple of kilometres near Mozda at Bal.

It is however north of the Narmada river, in the broken ravinous countryside around the river, that *S. fulicata* is a very common bird. We found atleast fourteen nests of this bird here in the first two weeks of June.

MALABAR WHISTLING THRUSH (*Myiophonus horsfieldii*)

In 'Birds of Gujarat' (*JBNHS* 52:775), Sálim Ali records *M. horsfieldii* only from the Surat Dangs forests, south of the Tapti river.

S. D. Ripley in SYNOPSIS gives the range of *M. horsfieldii* as, Abu, hills of western Gujarat, the Dangs and the Satpuras (Pachmarhi, Melghat).

We first came across the Malabar Whistling Thrush in the Rajpipla forests in June 1981 when it was seen along a flowing forest stream and then again in a more or less similarly forested country around a forest stream not far from Piplod. This was quite on the base of Daman-mahal mountain. We never saw this bird elsewhere in these forests. The second time when we saw this thrush, the bird was in song.

WHITETHROATED GROUND THRUSH (*Zoothera citrina*)

The only example of this species met by Sálim Ali during his Gujarat State Ornithological survey was in Navsari district, south of the Tapti river (*JBNHS* 52:770). Besides this specimen, the only other evidence of the presence of the bird in Gujarat is a specimen collected by E. M. Shull on 17th August 1954, with enlarged ovaries, thus indicating that the breeding season of *Z. citrina* in the Dangs is July-August (*JBNHS* 69:659).

In Rajpipla we found this thrush quite common in the better wooded parts. Our sightings of this bird in the Rajpipla area thus happen to be the northernmost in Gujarat. The birds were noticeably more often seen around Namgir in forest, where we were staying. In the first week of July 1981, this thrush was observed building its nest. Breeding was evidently in progress in July the next year too. SGM was baffled by the good variety of rich notes of this thrush in mid-July 1982, when a pair certainly had a nest but which could not be located. The breeding season of *Z. citrina* in Rajpipla forests should range between July-September. Around Betul in the MP Satpuras, this bird has been heard in song in April, but presumably breeding is later. B. B. Osmaston found this bird not uncommon around Pachmarhi in the central Satpuras in MP (*JBNHS* 28:456).

BLACKBIRD (*Turdus merula*)

The only occasion that we saw *T. merula* in the Rajpipla forests was on 4th January 1982 when trekking towards Upla-Juna-Rajpipla. A solitary male flew away along a forest stream into the bamboo forest nearby. We failed to locate this bird elsewhere on any of our further visits.

GREY TIT (*Parus major*)

A common bird in the forests where we observed it almost all the way from Bal towards Dumkhal and once also more than half way up Daman-mahal hill. A pair was also once seen in the vicinity of the PWDRH at Dediapada and in light forest along the Karjan river, a few kilometres from Rajpipla town. In the forests the Grey tits were apparently breeding in good numbers as could be understood by their very noisy and demonstrative nature and by their frequent entering of cavities and holes in trees and at times driving away other intruding birds from the vicinity of these potential nest sites.

YELLOW-CHEEKED TIT (*Parus xanthogenys*)

Often seen in the forests, though certainly not as common as *Parus major*. Seen at Namgir, Piplod, Daman-mahal hill, Mozda and once along the Karjan river in light forest. Sometimes we noticed a few of these birds entering into natural small cavities in trees and it appears that the birds were breeding in the first two weeks of June. We failed to check any of these cavities for eggs or nestlings.

SPOTTED GREY CREEPER (*Salpornis spilonotus*)

This bird is considered to be quite common in the dry deciduous forest here. However, we saw this bird for the first and only time here on 11th December when SGM and Eric D'Cunha were birdwatching in the forest a few kilometres from Namgir. There was only one bird and it was moving up a thin stem. We feel that this bird is one of the very difficult birds to be seen in forests here and we possibly overlooked it.

(Pipits on the lawns of the palace at Rajpipla, SGM observed some Tree-pipits (*Anthus*) in the first week of January 1982. There were atleast 15-20 birds in that small flock which was initially on the ground but on being approached took off and settled into the nearby trees. This is the only occasion that we saw these pipits in the Rajpipla area).

PADDYFIELD PIPIT (*Anthus novaeseelandiae*)

Nowhere common. Infact we saw this bird only around the Narmada river, around the Karjan river and once near the PWDRH at Dediapada in a field. No indication of its breeding.

FOREST WAGTAIL (*Motacilla indica*)

SGM and D'Cunha saw this bird on 10th Dec. 1982 in forest near Namgir. The bird was on a forest stream on the ground. In 'Birds of Gujarat' (*JBNHS* 52:779), Sálim Ali came across this wagtail only in the Dangs forests south of the Tapti river and nowhere else though he also presumes that it may occur in the Gir forests of Junagadh in Saurashtra. In SYNOPSIS S. D. Ripley gives the winter range of *M. indica* as the Western Ghats complex from Mahableshwar southwards. *M. indica* has also straggled to Kutch in Gujarat. Also, *M. indica* is an irregular winter visitor to the Bombay area.

GREYHEADED YELLOW WAGTAIL (*Motacilla flava thunbergi*)

Seen in small numbers in December-January in the palace lawns in Rajpipla, around the PWDRH at Dediapada and occasionally even along the forest streams. SGM has once seen this bird till as late as the first week of May in the neighbourhood of Baroda city.

BLUEHEADED YELLOW WAGTAIL
(*Motacilla flava beema*)

This race of *M. flava* can be distinguished from *M. f. thunbergi* by the presence of a distinct white superciliary stripe over the eyes. We saw this wagtail and confirmed its identity on atleast five occasions. It happens to be a somewhat less common winter migrant than *M. f. thunbergi.* We saw it around Dediapada, at Juna-Rajpipla (on river-bed) and along the Mozda river.

BLACKHEADED YELLOW WAGTAIL
(*Motacilla flava melanogrisea*)

In January 1982, we came across a solitary bird on the Karjan riverbed which was of this race. We never saw this bird again in the area on any of our subsequent visits.

GREY WAGTAIL
(*Motacilla cinerea*)

A common winter visitor to the area. Seen in good numbers on the Karjan river. Seen in association with other wagtails around Dediapada. Also seen in the neighbourhood of Rajpipla town, and occasionally even in the forest along streams. Near Baroda, SGM once saw this wagtail in bright breeding plumage, with black chin and throat and foreneck (with a prominent white moustachial streak) on 11th May.

WHITE WAGTAIL
(*Motacilla alba*)

A winter visitor. Quite common. Seen on several streams and rivulets along the road between Dediapada and Rajpipla, near the PWDRH at Dediapada, on the Karjan and Narmada rivers and also along forest streams occasionally. This wagtail normally prefers to remain in pairs and does not seem to like associating with other wagtails.

LARGE PIED WAGTAIL
(*Motacilla maderaspatensis*)

A common bird on the Narmada river and we also saw it on the Karjan, around Dediapada and also along the Mozda river. On the banks of the Narmada river, a few kilometres on either side of Chandod, we found this bird breeding in good numbers, both on the northern as well as on the southern banks of the river. In the first two weeks of June '81, SGM located five nests of this wagtail. While two of these nests were actually built in holes on flat and stony ground, the remaining three nests were in cavities in rocks and one in the mud-wall along the river. The two nests in rock cavities were big and thickly built cups of grasses, fibres, hair and a lot of moss. The nests in the holes on flat ground were more like lark-nests, though somewhat deeper and thicker. Only two of these nests actually contained nestlings in them while in two others, the nestlings could be seen around the nest. Just a day after SGM found the two nests with nestlings in them, the young birds had come just out of the nest and the parents could be seen going to different places with food in their beak because the nestlings had all scattered around the nest. Infact from one of these nests, the nestlings flew out only when SGM put his hand inside the hole to check. Hardly had he done so when four young wagtails, lacking the long tails which are so characteristic of them, barged out of the nest, uttering sharp squeaky calls and one of them actually settled on SGM's shoulder. This sudden coming out of the nest of the nestlings at intrusion, greatly agitated the adult wagtails who ventured extremely close to SGM with some large worms in their beaks. The parents made a number of visits to feed their nestlings. It was observed that they were collecting the food for the nestlings from a small moss covered puddle, some fifty odd feet from the river.

THICKBILLED FLOWERPECKER
(*Dicaeum agile*)

Occasionally seen in forest. A rather uncommon bird.

TICKELL'S FLOWERPECKER
(*Dicaeum erythrorhynchos*)

Often seen. A noisy bird, also met with in Rajpipla town environments, around the Karjan river and even at Dediapada. No signs of breeding.

PURPLERUMPED SUNBIRD
(*Nectarinia zeylonica*)

Ripley in SYNOPSIS gives the range of this bird as "Peninsular India, south of a line from Nasik (NW. Maharashtra), Jabalpur (central MP), Lohardaga (Bihar), southern Bengal and Bangladesh southwards into India.

Salim Ali in 'Birds of Gujarat' (*J. Bombay nat. His. Soc.*, 52:787) states as having only a single unconfirmed sight record of *N. zeylonica* from Pavagadh in Panchmahals district of Gujarat.

We have two sightings of this sunbird. While one of these was in an orchard several kilometres from Netrang, the other was seen in light forest along the Karjan river. As such, we would state that *N. zeylonica* is present, certainly in very small numbers, in the Rajpipla area north of the Tapti river, and probably also elsewhere in south-eastern Gujarat.

SMALL SUNBIRD
(*Nectarinia minima*)

We first saw some tiny sunbirds with deep crimson on their throat and breasts just behind the residence of the forest guard at Piplod on our very first day in these forests in the third week of June '81. There were about six to eight birds and though we had not properly identified them we were definitely sure that they were not *N. zeylonica* or *A. siparaja*. The upper plumage of these sunbirds we had seen in Rajpipla forests was also a lovely shade of deep crimson (somewhat less bright than the breast), in no way similar to the red-scarlet of *A. siparaja*. The head and crown were metallic greenish. There was a darkish band below the deep crimson on the breast. Also, the underparts below the breast were very yellow and not half as bright yellow as in *N. zeylonica*. The crimson on the breast of these birds was also much deeper than on that of *N. zeylonica*, also, in which, the crimson does not extend so deep down the breast.

When back in Bombay in late July '81, we checked all the references and all the *Nectarinia* species in the BNHS collection. On examination of all these specimens we noticed that the tiny sunbirds we had observed from so close in the forest guard's compound at Piplod in the Rajpipla forests completely matched the description and the specimens of *Nectarinia minima*.

In May '82, when we again went to these forests we came across this sunbird in forest around Namgir. RKN now saw this bird from the hide while photographing Serpent Eagle from very close, and he noted down all the details of the birds he had seen. We once again reviewed the specimens in the BNHS collection and we feel that *Nectarinia minima* has probably extended its range northwards into South-eastern Gujarat, in the area between the Tapti and Narmada rivers, and presumably also in the Dangs forest, south of the Tapti and at the northern extremity of the Western Ghats.

Presently the northernmost sighting of

N. minima are from Suriamal, north of Bombay.

PURPLE SUNBIRD
(*Nectarinia asiatica*)

A common bird in the area, both in the forests as well as in the towns here. A nest with two eggs was found in the compound of the PWDRH at Dediapada. Males in bright plumage were very noisy and demonstrative in January and it appears that this bird certainly breeds twice in a year. In the vicinity of Bombay, SGM has found nests with eggs and/or nestlings in January, March, June, July, September and also in November. This certainly indicates that *N. asiatica* breeds irregularly, atleast around Bombay.

YELLOWBACKED SUNBIRD
(*Aethopyga siparaja*)

Present in appreciably good numbers in these forests. We also saw this bird from the hide when photographing the Serpent Eagle. No signs of breeding during any of our visits to the area. Presumably breeds after the onset of the rains.

Sálim Ali (*J. Bombay nat. His. Soc.* 52:788) records the northward extension of *A. siparaja* to the Rajpipla area and further towards the Narmada river.

WHITE-EYE (*Zosterops palpebrosa*)

Quite a common bird in the area, particularly in light open and scrub forest where this bird is always seen in small parties, often along with some other small avian denizens of the forests and scrubs. In December and January this bird was noticeably more common around Dediapada.

HOUSE SPARROW
(*Passer domesticus*)

Common till Dediapada, but after that it becomes noticeably less common towards Piplod and Dumkhal. Breeding almost everytime we went. At Mozda, one of the best sites of this bird's breeding is the ashram.

YELLOWTHROATED SPARROW
(*Petronia xanthocollis*)

There are definitely some local seasonal movements of this species in this area, as is also probably in the neighbourhood of Bombay. This is a common bird in the forests here and the birds were certainly nesting in May-June. However, in July SGM came across very few (almost negligible) of these sparrows here. In December-January we saw small flocks of a dozen to as many as seventy or so of *P. xanthocollis* in the forest here, particularly around the Karjan river. SGM noticed similar, infact once a flock of atleast 150-200, of this sparrow in the Borivli park — Bombay in December-January. In the third week of February there were none or very small flocks of 6-10 birds here, most of the flock having split into pairs some of which had infact commenced breeding by this time.

BAYA WEAVER
(*Ploceus philippinus*)

A noticeably uncommon bird at and around Dediapada, though, in the open countryside south and north of the Narmada, small scattered breeding colonies of the baya may be observed almost anywhere. In Dediapada town, a small breeding colony of six completed and one partly built nests was noticed on a date palm in July '82. There was however only one male to be seen there.

GREEN MUNIA
(*Estrilda formosa*)

Thrice we saw this bird in small groups. The birds keep to the low vegetation. Seen along the Mozda river, Samot road and once near Moti-Singloti, several kilometres from Mozda towards Dediapada. No signs of breeding.

SPOTTED MUNIA
(*Lonchura punctulata*)

In July this bird was seen near Dediapada and then in January in the vicinity of Rajpipla town. No signs of breeding.

BLACKHEADED MUNIA
(*Lonchura malacca*)

Since we saw only a single example of this bird in the reedbeds around the Wadhwana tank at Dabhci, about 20 kms. north of the Narmada river, this bird certainly does not deserve mention in this list. But since this bird has not been included in Sálim Ali's list on 'Birds of Gujarat' (*JBNHS* 52, Nos. 2, 3 & 4) and probably also because this sighting may be the first for Gujarat state, this bird is mentioned here. In SYNOPSIS, S. D. Ripley gives the range of (*L. m. malacca*) as "Indian peninsula from Raipur (MP), Pachmarhi and Bombay (*JBNHS* 62:559-60) south into South India." The sighting of this munia at Dabhoi, north of the Narmada, is thus considerably north of the line of distribution as given by Ripley. Since this munia is also such a widely kept cage-bird everywhere, it is also probable that the bird we saw at Dabhoi was an escaped one. There was a solitary bird and no other was in sight anywhere around.

CONCLUSION

It must be stated here that Rajpipla forests contain an astonishing variety of birds, migrants and the local breeders. This area also has a good density of raptors, especially the Crested Serpent Eagles and many species of nocturnal owls. Logging as of two years ago is being carried out on a vast scale. The newly designated Piplod Bird Sanctuary is in shambles and about 40 per cent of its existing tree cover has been decimated. A network of roads to facilitate carting away lorry loads of timber has accelerated considerably the extensive deforestation of the area.

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NEW DESCRIPTIONS

A NEW SPECIES OF *LAGENANDRA* DALZELL (ARACEAE) FROM KERALA STATE, INDIA[1]

K. Ramamurthy and R. Rajan[2]

(*With eleven text-figures*)

Lagenandra nairii sp. nov.

L. undulata Sastri affinis sed praecipue differt: vagina stipulari longa elongato-triangulata, petiolo lamina longiore dense tomentoso, lamina ampliore elliptico-oblonga ad ovata plerumque integro subeter dense tomentosa insuper punctata coriacescens quum siccatis, apice acuto, basi auriculata, lobis distinctis, nervis multis, nervillis parallelis, pedunculo crasso paginis uterque convexis piloso non striato, spatha ampliore, limbo longe acuminato obtuse serrato, serraturis basi pluribus, appendice sterili supra inflorescentiam masculam ovata, baccis ovoidis tetrangulis distincte verrucosis, verucis spinulosis, seminibus oblique ovatis.

Lagenandra nairii sp. nov.

Allied to *L. undulata* Sastry, but differs chiefly in: stipular sheath longer, elongate-triangular; petiole longer than the lamina, dense tomentose; lamina larger, elliptic-oblong to ovate, mostly entire, acute at apex, auricled at base, punctate above, dense tomentose below, becoming leathery on drying, nerves numerous, nervules parallel; peduncle thick, convex on both sides, pilose, not striated; spathe larger, limb blunt serrated, more near the base, long-acuminate at apex; sterile appendage above male inflorescence ovate; berries ovoid, 4-angled, distinctly warted, warts spinulose; seeds obliquely ovate.

Submerged herbs; rhizomes 1.5-2 cm across, creeping, annulate; roots thick, fibrous; stipular sheath 5-10 cm long, elongate-triangular, leathery, thick, transparent, shiny, glabrous, deciduous, acuminate at apex, 2.5-3 cm wide at base. Leaves 25-40 cm long, alternate, sheathed, arising from the rootstock; leaf blades 12-18 x 4.5-9 cm. elliptic-oblong to ovate, entire or undulate, dark green and punctate above, dense tomentose and pale green beneath, leathery when dry, acute at apex, auricled at base; nerves numerous, distinctly arising from the broad midrib, ascending widely arched upwards to the tip, nervules parallel, linking the ascending nerves; petiole 20-30 cm long, sheathed at base, adaxially grooved, tomentose throughout; sheath thin, transparent, membranous at base. Peduncles 4-5 cm long, thick, convex on both sides up to 5 mm wide, axillary, partly enclosed in the leaf-sheaths. Spathe 4-5 cm long, about 1 cm across, tubular below, constricted in the middle, hairy without; limb ovate, acuminate, slightly twisted clockwise, blunt serrated, more near the base, pinkish; obliquely septate near the constriction within. Male flowers numerous, subterminal, about 5 mm long, oblong near the top of the spadix, crowned with an ovate,

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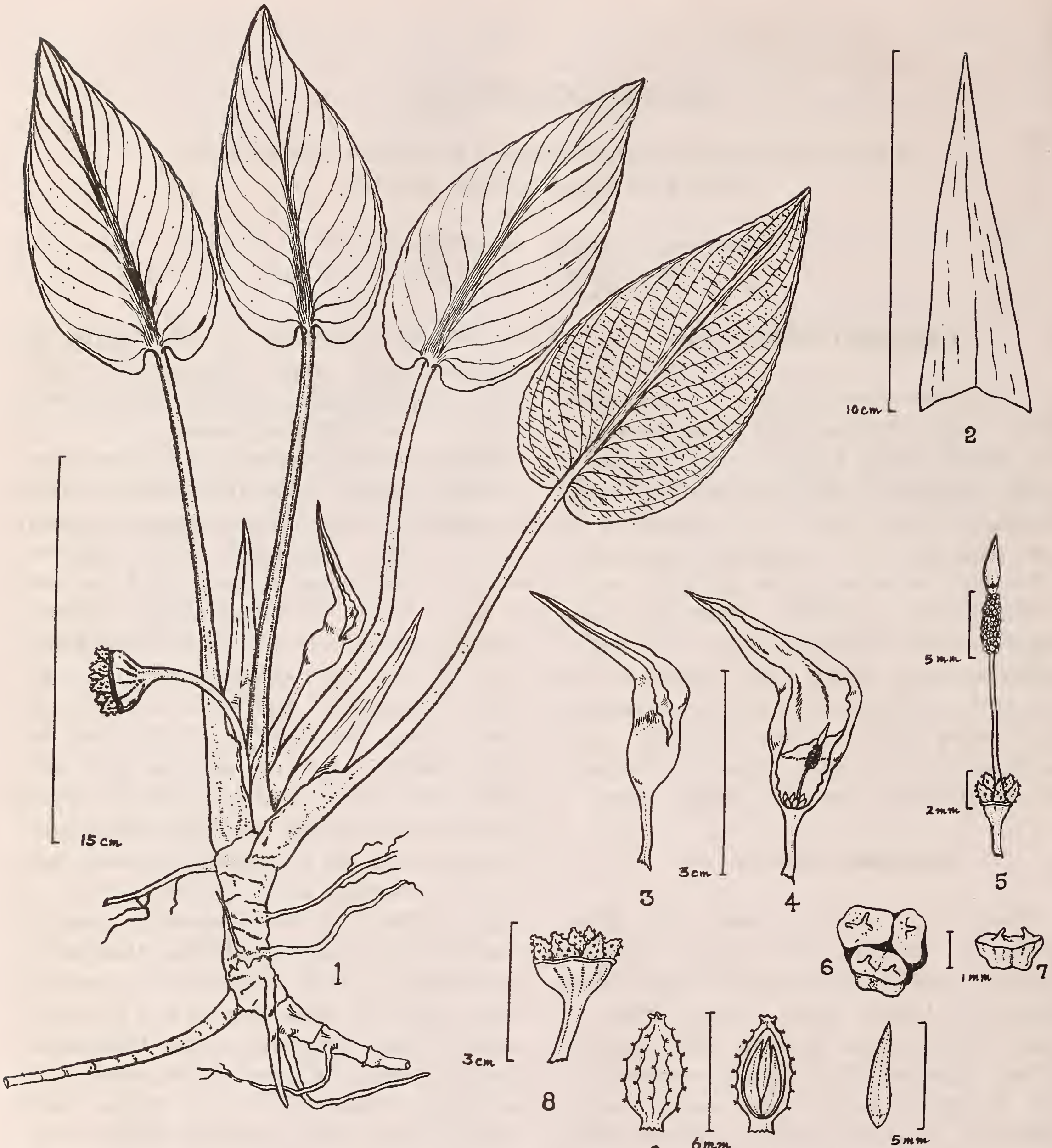
[1] Accepted July 1982.

[2] Botanical Survey of India, Coimbatore 641 003.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Lagenandra nairii sp. nov.

1. Habit sketch; 2. Stipular sheath; 3. Typical flower; 4. Spathe split open exposing the spadix; 5. Spadix showing arrangement of male and female flowers with neutral appendage; 6. Arrangement of male flower (a portion); 7. Typical male flower; 8. Syncarpium enclosed in the basal part of spathe; 9. Typical berry; 10. L. S. of berry; 11. Seed.

fleshy, sterile appendage; anthers sessile, crowded, cupular with one or two small tubular appendages inside. Female flowers 1-2 mm long, separated from the male by a naked portion 6-8 mm long; ovaries sessile, one loculed, many in whorls, warted, punctate; stigma small, globose; ovules 4, basal, elliptic-oblong, striated. Syncarpium enclosed in the persistent, cupular basal part of the spathe; berries 5-8 mm long, ovoid, 4-angled, distinctly warted, warts spinulose; seeds about 5 mm long, obliquely ovate, elongate, striated, longitudinal ridges distinct, punctate.

Holotype *Rajan* 73052 and paratype *Ramamurthy* 66279 (CAL) and Isotypes *Rajan* 73052 (Acc. nos. 112271-112275, MH) and paratype *Ramamurthy* 66279 (Acc. nos. 112276 & 112277, MH) were collected near the base of the Adirappally waterfalls as fully submerged patches in fresh, running water on the bank of the Chalakudi river, Trichur District, Kerala State, India at an altitude of about 300 m on 17-3-1982 (Holotype and Isotypes) and from the same locality on 22-3-1981 (Paratypes).

The specific name is given in honour of Dr. N. Chandrasekharan Nair, D.Sc., Joint Director, Botanical Survey of India, Southern Circle, Coimbatore for his valuable contributions to Indian Botany.

ACKNOWLEDGEMENTS

We wish to express our thanks to Dr. Dan H. Nicolson, Department of Botany, Smithsonian Institution, Washington, U.S.A. for his valuable comments on this taxon during his recent visit to MH. Our thanks are also due to Dr. V. J. Nair for latin diagnosis, Dr. A. N. Henry, Regional Botanist for his valuable suggestions and to the Director, Botanical Survey of India, Howrah and Joint Director, Botanical Survey of India, Southern Circle, Coimbatore for their constant encouragement during this investigation.

A NEW SPECIES OF *DIMERIA* R. BR. (POACEAE) FROM KOLLIMALAI, SOUTH INDIA[1]

M. MOHANAN AND A. V. N. RAO[2]

(With ten text-figures)

The Genus *Dimeria* R. Br. consists of 40 species all over the world of which 20 species are so far reported from India (Willis 1973, Santapau & Henry 1973). Fischer (1957) recorded only 10 species from the former Presidency of Madras. Bor (1969) described 25 species and 4 varieties of which only 18 species are from India, others being from Burma and Sri Lanka. Almeida (1970), Sreekumar *et al.* (1981 & 1982) made three new additions making the total 21. During a recent plant exploration tour to Kollimalai, Salem District, South India, a species of *Dimeria* R. Br. was collected. A critical study of the specimens and a careful comparison with allied species of the genus, recently identified from Kew, England, proved that it is quite distinct from all other species and is described here as a new species. The species is closely allied to *Dimeria deccanensis* Bor but differs from the latter in the following characters :

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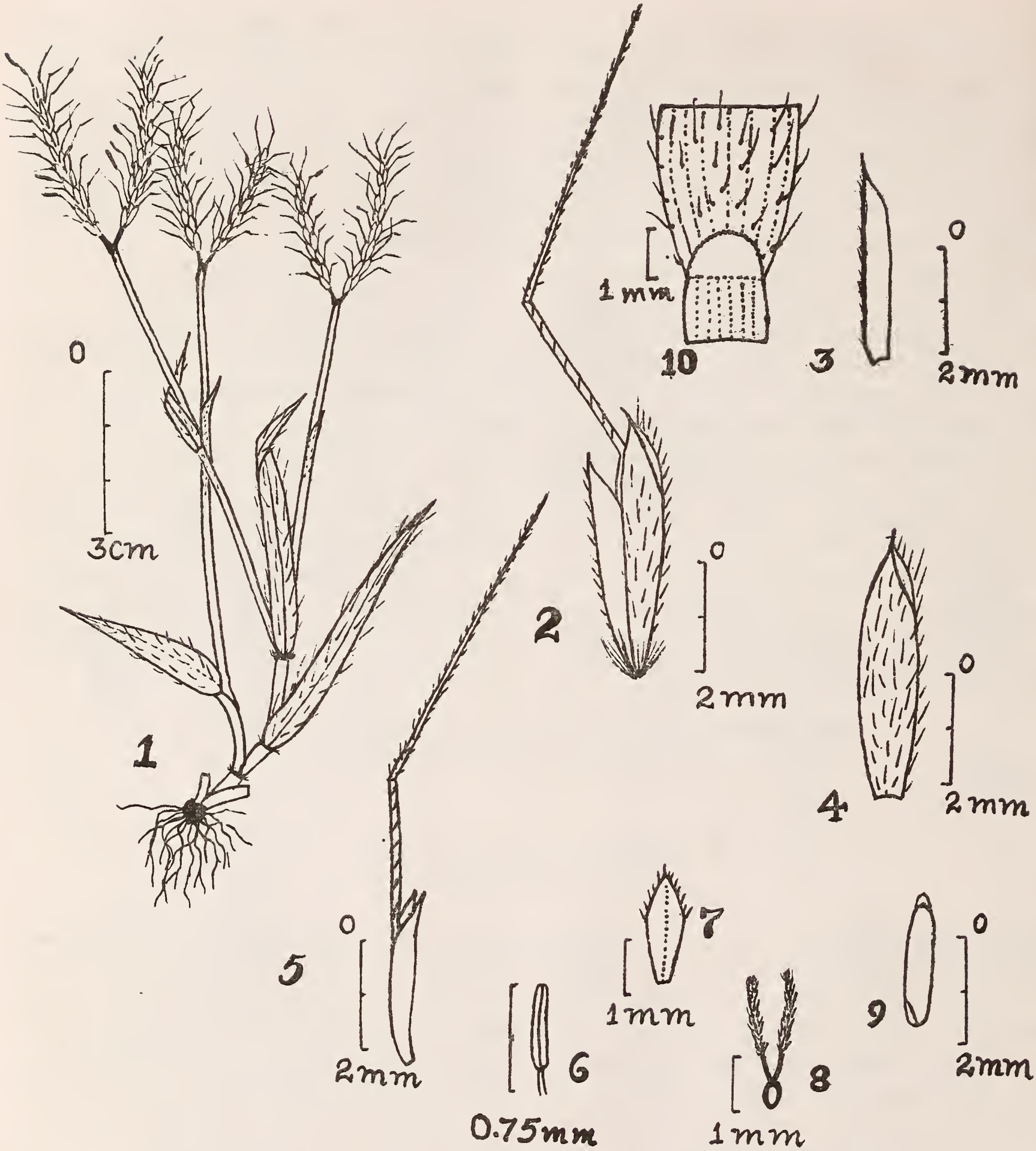
[1] Accepted July 1982.

[2] National Orchidarium and Experimental Garden, Botanical Survey of India, Yercaud.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Figs. 1-10. *Dimeria kollimalayana* sp. nov.
1. Habit; 2. Spikelet; 3. Lower glume (Lateral view); 4. Upper glume (Lateral view); 5. Upper lemma; 6. Stamen; 7. Lower lemma; 8. Pistil; 9. Grain; 10. Part of leaf showing ligule.

Characters	'*Dimeria deccanensis* Bor'	*M. Mohanan* 56208
Culms	Up to 70 cm tall	up to 20 cm tall
Ligule	a ciliate membrane	not ciliate
Racemes	4-7 cm long	up to 3 cm long
Rhachis	margins ciliate	margins glabrous
Callus	Up to *c.* 0.5 mm long	Up to *c.* 1 cm long
Spikelets	2.5-3.5 mm long	4-4.5 mm long
Glumes	acute at apex	shortly acuminate at apex
Lower glumes	villous	glabrous
Anthers	*c.* 1.5 mm long	up to 0.75 mm long

Dimeria kollimalayana sp. nov.

Dimeria deccanensis Bor affinis, sed ligulis non ciliatis, marginibus rhachis glabris, pilis calli longioribus, glumis infernis glabris, antheris parvioribus (usque ad 0.75 mm differt).

Holotypus *M. Mohanan* 56208 et isotypi in Kollimalai in Salem District ditione Tamil Nadu ad altit. ± 1200 m, die 19-2-1982. Holotypus positus ad CAL; isotypi ad MH.

Annuals. Culms 10-20 cm tall; nodes sparsely bearded. Leaves 2-6 × 0.3-0.4 cm, lanceolate, rounded at base, villous with tubercle based hairs, midrib prominent. Sheaths 1-5 cm, basal ones longer than the internodes, upper ones shorter, keeled, covered with sparse tubercle based hairs in the upper half. Racemes 2, each 2-3 cm long, divergent. Rhachis *c.* 0.75 mm wide, flattened, keeled in a zig-zag manner, margins glabrous, Callus hairs 0.5-1 mm long. Spikelets 4-4.5 mm long oblong-lanceolate, acuminate, villous. Lower glumes 3.5-4 × 0.3-0.5 mm, linear-lanceolate, acuminate, scabrid. Upper glumes 4-4.5 × 1-1.25 mm, oblong-lanceolate, acuminate, winged at apex, densely villous with a few long hairs at tip, margin hyaline. Lower floret empty; lemma 1.5-2 × 0.3-0.5 mm, oblanceolate, delicate, hyaline, faintly 1-nerved, margin ciliate in the upper half. Upper floret bisexual; lemma 2.5-3 × 0.75-1 mm, 2 lobed at apex, awned in between, lobes acuminate, delicate, faintly 1-nerved; awns 8-10 mm long, geniculate, column *c.* 3 mm long, brownish, twisted, bristle pale, scabrid; stamens 2, anthers 0.5-0.75 mm, long; filaments short; ovary *c.* 0.25 mm long, elliptic, styles *c.* 0.25 mm long, slender, stigmas *c.* 0.75 mm long feathery; grains *c.* 2 × 0.4 mm, oblong.

Holotype *M. Mohanan* 56208 and isotypes were collected from Kollimalai in Salem District, Tamil Nadu, at an altitude of 1200 m on 19-2-1982. The Holotype is deposited in CAL. The Isotypes are deposited in MH.

Dimeria kollimalayana grows on the exposed slopes of hills in Sothuparai, Kollimalai.

ACKNOWLEDGEMENTS

We are grateful to Shri P. V. Sreekumar, Botanical Survey of India, Coimbatore for help and to Dr. V. J. Nair, B.S.I., Coimbatore for help in identification and the latin diagnosis. Thanks are also due to Dr. N. C. Nair, and Dr. A. N. Henry, Botanical Survey of India, Coimbatore for encouragement.

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TWO NEW SPECIES OF EULOPHIDAE (HYMENOPTERA: CHALCIDOIDEA) FROM ANDAMAN ISLANDS[1]

S. ADAM SHAFEE, ANIS FATMA,
M. YOUNUS KHAN AND SHUJAUDDIN[2]

(*With four text-figures*)

Euplectrus latifrons sp. nov. and *Pediobius infuscatipennis* sp. nov. are described and illustrated. The new species are compared from their closely allied species. Types deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Euplectrus latifrons sp. nov.
(Figs. 1 & 2)

FEMALE

Head dark, with coarse setae, wider than long in facial view; frontovertex slightly more than twice as wide as long, width slightly more than half the total head width; ocelli white, arranged in obtuse triangle, lateral ocelli about twice their own diameters from orbital margins and near to occipital margin; eyes red; antennae inserted at lower level of eyes, inter-antennal space about one-third the width of frons at median ocellus; malar space as long as eye width. Antennae (fig. 1) yellowish brown; scape four times as long as wide; pedicel one and a half times as long as wide, distinctly shorter than first funicle segment; one ring segment present; funicle segment first longest, slightly less than twice as long as wide; segments second, third and fourth subequal, each one and a half times as long as wide; club 2- segmented, slightly more than two times as long as wide, shorter than preceding two funicle segments together.

Thorax dark with coarse setae; pronotum much narrower than mesoscutum, strongly arched; mesoscutum with well developed parapsidal furrows; scutum and scutellum with three and two pairs of setae respectively; propodeum with raised median and two low sublateral carinae. Fore wings (fig. 2) hyaline, slightly less than two and a half times as long as wide; costal cell broad with coarse setae; submarginal vein slightly shorter than marginal vein; postmarginal vein about twice the

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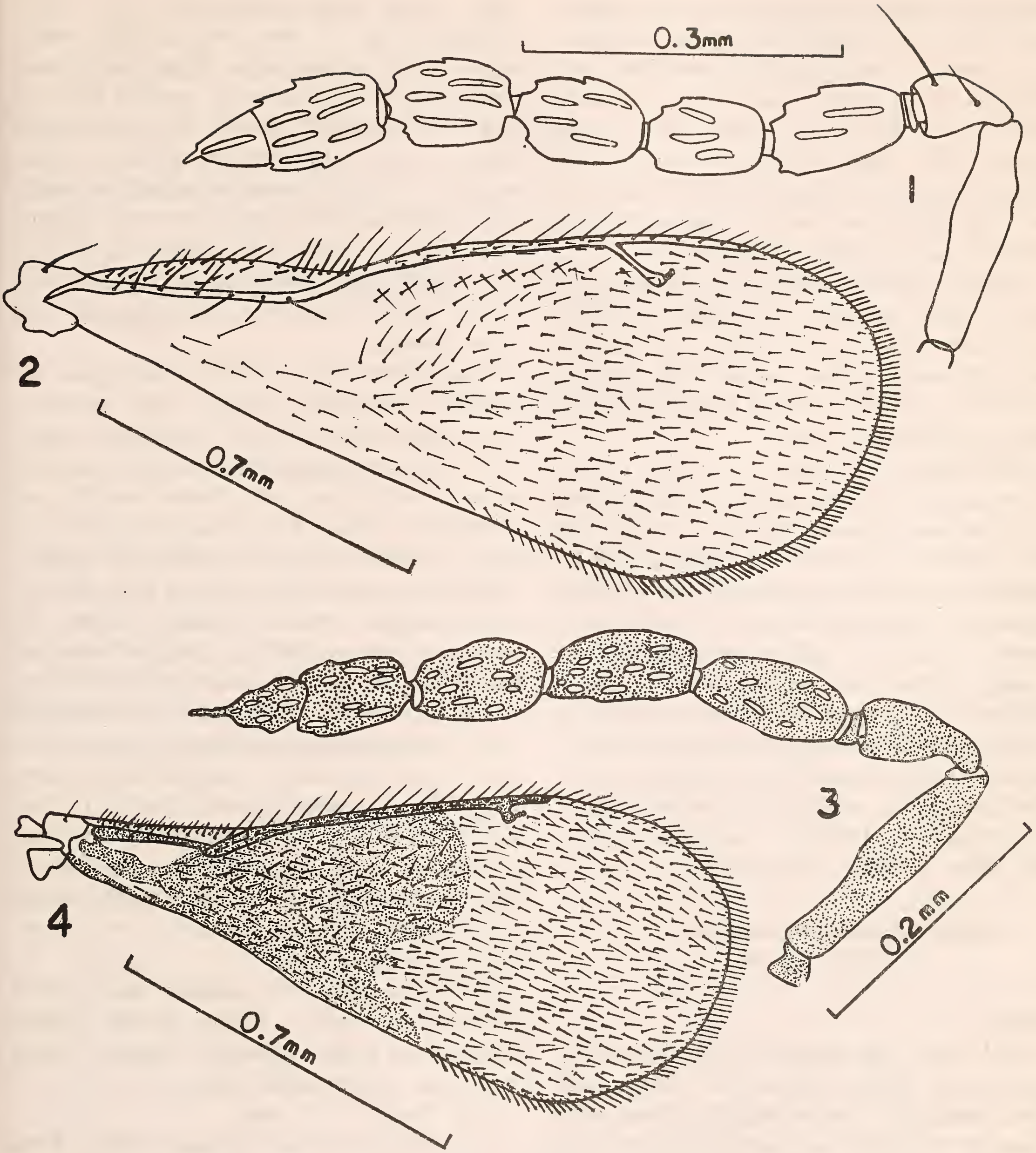
[1] Accepted August 1982.

[2] Department of Zoology, Aligarh Muslim University, Aligarh, India.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Figs. 1 & 2. *Euplectrus latifrons* sp. nov., ♀:
(1) Antenna; (2) Fore wing.
Figs. 3 & 4. *Pediobius infuscatipennis* sp. nov., ♀:
(3) Antenna; (4) Fore wing.

length of stigmal vein; marginal and postmarginal veins with 10 and 6 long setae respectively; a row of 9 setae beneath the marginal vein; marginal fringe short, spaced by a distance equal to one-fifth their length. Hind wings hyaline, four times as long as wide; Legs yellow; tarsi four segmented; hind legs with two long tibial spurs, longest spur as long as basal two tarsal segments together.

Abdomen yellow except petiole, lateral margins of basal two-thirds and apical one-third of dorsum dark; petiole slightly longer than wide; abdomen slightly longer than thorax; ovipositor concealed, arising from basal one-third of abdominal venter.

Body length: 1.9 mm.

Comments: The new species is closely allied to *Euplectrus gopimohani* Mani (Khan and Shafee 1979: 324-326) from which it can be separated by its having antennae with pedicel shorter than first funicle segment, funicle segments 2-4 each one and a half times as long as wide; stigmal vein one-fourth the length of marginal vein; longest tibial spur of hind legs as long as basal two tarsal segments together; abdomen yellow except lateral margin of two-thirds and apical one-third of dorsum dark.

Holotype ♀, INDIA: Andaman Island, Port Blair, 8,3.1982 (*Shujauddin*).

Pediobius infuscatipennis sp. nov.

(Figs. 3 & 4)

FEMALE

Head dark with metallic bluish reflections; frontovertex slightly wider than long; ocelli white, arranged in obtuse triangle, lateral ocelli separated by twice their own diameters from occipital margin; eyes silvery white, with small sparse hairs; antennae inserted above lower level of eyes, inter-antennal space about one-third the width of frons at median ocellus; malar space much shorter than eye width. Antennae (fig. 3) dark with metallic reflections; radicle small; scape slightly more than four times as long as wide; pedicel twice as long as wide, slightly shorter than first funicle segment; one ring segment distinct; funicle segments first and second subequal in length, each about twice as long as wide, third slightly more than one and a half times as long as wide; club 2-segmented, apical segment with a long style; funicle and club segments with short sensoria.

Thorax dark with metallic bluish-green reflections; pronotum narrower than mesoscutum; mesoscutum coarsely reticulated; parapsidal furrows complete; axillae and parapside smooth; propodeum with distinct median and sublateral carinae. Fore wings (fig. 4) with basal one-half infuscated, apical half hyaline; slightly more than two times as long as wide, apical margin broadly rounded; costal cell narrow, about one-half the length of marginal and 4 setae respectively; marginal fringe short, less than one-half the length of postmarginal vein; marginal and post-marginal veins with 17 and 4 setae respectively; marginal fringe short, spaced by a distance equal to one-fourth their length. Hind wings slightly infumate, four times as long as wide; marginal fringe one-fifth of wing width. Legs dark with metallic bluish green reflection except basal three tarsal segments of all legs white.

Abdomen dark with metallic bluish green reflection, as long as thorax; petiole slightly wider than long; ovipositor hidden, arising from base of abdominal venter.

Body length: 1.42 mm.

Comments: The new species differs from all the known species of *Pediobius* in having fore wings infuscated at basal half.

Holotype ♀, INDIA: Andaman Island, Port Blair, 8.3.1982 (*Shujauddin*).

ACKNOWLEDGEMENT

We are deeply indebted to Prof. Nawab H. Khan, Chairman, Department of Zoology, for providing research facilities.

REFERENCE

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A NEW SPECIES OF *PSYCHOTRIA* L. (RUBIACEAE) FROM KERALA STATE, INDIA[1]

K. RAMAMURTHY AND R. RAJAN[2]

(*With six text-figures*)

Psychotria sekharana sp. nov.

Psychotria nudiflora Wight & Arn. affinis sed praecipue differt: Foliis lanceolatis ad oblanceolatis, apice acuto; inflorescentia dichotome corymbosa; pedunculis curtis; bracteolis minutis, deciduis; tubo corollae calyce 4-5 plo longioribus, parte oris annulo uno pilorum; corolla 5-lobata, apicibus lobis incrassatis; staminibus 5, prope orem corollae exorientibus.

Psychotria sekharana sp. nov.

Allied to *P. nudiflora* Wight & Arn. but differs chiefly in: Leaves lanceolate to oblanceolate, acute at apex; inflorescence dichotomously corymbose; peduncles short; bracteoles minute, deciduous; corolla tube 4 to 5 times longer than the calyx; a ring of hairs at the mouth inside; corolla 5-lobed, lobes thickened at tips; stamens 5, arising near the mouth of corolla.

Shrubs; branchlets terete, scars of fallen inter-petiolar stipules and leaves distinct; tender parts compressed. Leaves 12-18 x 2-4 cm, lanceolate to oblanceolate, entire, glabrous, thick, leathery, acute at apex, tapering at base; nerves 2 to 10 pairs arising from the main nerve; nervules distinctly reticulated; main nerve dorsally grooved, shallow; stipules interpetiolar, deltoid, acute or bifid at apex, thick, glabrous, distinct, deciduous; petioles 1-2 cm long. Inflorescence dichotomously corymbose, terminal, dense; peduncles short; bracteoles minute, deciduous. Calyx 1 mm long, campanulate, truncate, sometimes minutely toothed, glabrous. Petals 4 mm long, tubular, white, straight, glabrous without, with a ring of hairs at the mouth within, 5-lobed, lobed halfway, lobes thickened at tip, valvate in bud. Stamens 5, inserted on the mouth of corolla; filaments upto 1 mm long; anthers oblong, dehiscing longitudinally. Ovary 2-loculed; style short; stigma bilobed, thick, distinct. Fruits not seen.

Holotype *Ramamurthy* 66275 (CAL) and isotypes *Ramamurthy* 66275 (Acc. nos. 116341 to 116343 MH) were collected on the banks of Kannankuzhi riverside, Trichur District, Kerala at an altitude of 250 m on 22-3-1980.

The specific name is given in honour of Dr. N. Chandrasekharan Nair, D.Sc., Joint Direc-

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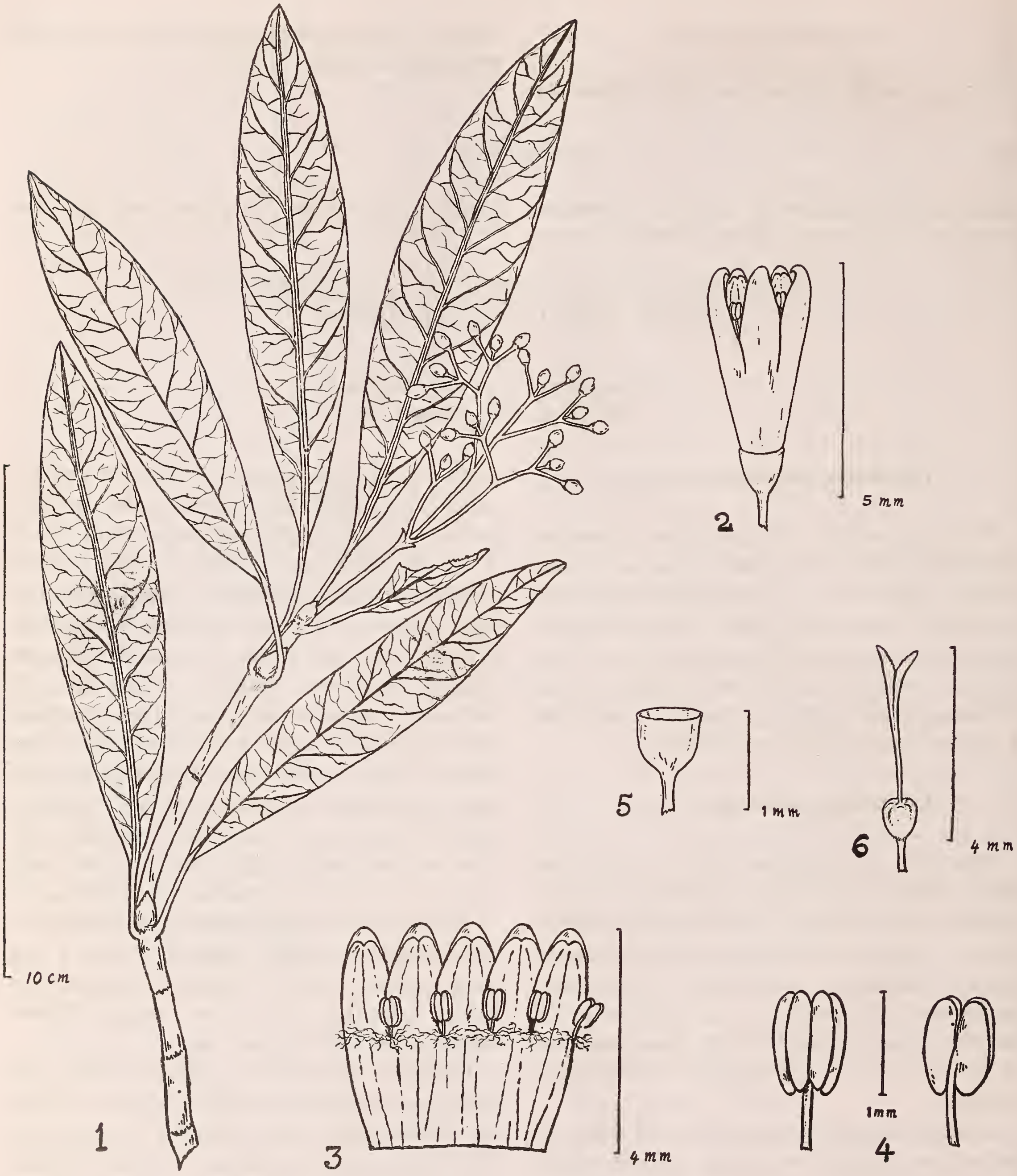
[1] Accepted September 1982.

[2] Botanical Survey of India, Coimbatore 641 003.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Figs. 1-6. *Psychotria sekharana* sp. nov.
1. Habit sketch; 2. Typical flower; 3. Corolla tube opened showing the arrangement of stamens; Fig. 4. Stamens; 5. Calyx; 6. Gynaecium.

tor, Botanical Survey of India, Southern Circle, Coimbatore, India for his valuable contribution, to Indian Botany.

ACKNOWLEDGEMENTS

We wish to express our thanks to the Deputy Director, Botanical Survey of India, Central National Herbarium, Howrah for his valuable comments on this taxon. Our thanks are also due to Dr. V. J. Nair for latin diagnosis, Dr. A. N. Henry, Regional Botanist for his valuable suggestions, to the Director, Botanical Survey of India, Howrah and Joint Director, Botanical Survey of India, Southern Circle, Coimbatore for their constant encouragement during this investigation.

DESCRIPTIONS OF THREE NEW SPECIES OF *GONATOCERUS* NEES (HYMENOPTERA: MYMARIDAE) FROM ALIGARH (INDIA)[1]

S. M. SHAMIM[2] AND S. ADAM SHAFEE[3]

(*With ten text-figures*)

Three new species of *Gonatocerus* Nees (*G. alami* sp. nov., *G. aligarhensis* sp. nov., and *G. terebrator* sp. nov.,) are described and illustrated. Types deposited in Zoological Museum, Aligarh Muslim University, Aligarh, India.

Gonatocerus alami sp. nov.

(Figs. 1-3)

FEMALE

Head brownish; antennae inserted much above lower level of eyes; malar sutures distinct; malar space about one-half the eye width; mandibles tridentate; eyes dark and sparsely setose. Antennae (fig. 1) yellowish; radicle cylindrical, slightly more than one-half the length of scape; scape slightly dilated, slightly less than three times as long as wide, distinctly shorter than following three segments together; pedicel less than twice as long as wide, distinctly longer than first funicle segment; funicle segment first longest, twice as long as wide, segments second and third subequal, each slightly more than twice as long as wide, segments fourth, seventh and eighth subequal in length, each one and a half times as long as wide; club entire, slightly more than three times as long as wide, as long as preceding four funicle segments together.

Thorax dark brown. Fore wings (fig. 2) hyaline, long and narrow, about four times as long as wide; marginal vein shorter than submarginal vein, postmarginal vein absent, stigmal vein developed; marginal fringe about one half of wing width. Hind wings hyaline, very long and narrow; marginal fringe seven times the wing width. Legs orange yellow; fore tibial spur curved; tarsi 5-segmented.

Abdomen (fig. 3) brownish, slightly longer than thorax; ovipositor unexserted, arising from base of abdominal venter.

Body length: 0.88 mm.

Comments: This new species is closely allied to *G. uttarodeccanus* Mani & Saraswat, 1973 but differs from it in having body mostly yellow, unexserted condition of ovipositor and

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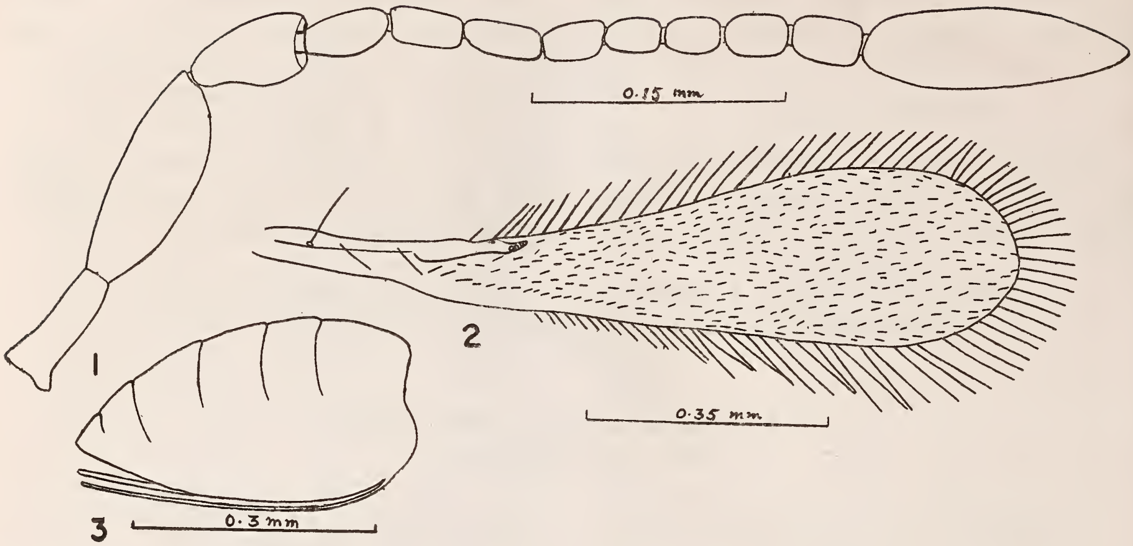
[1] Accepted June 1982.

[2] Department of Zoology, Ranchi University, Ranchi, India.

[3] Department of Zoology, Aligarh Muslim University, Aligarh, India.



Figs. 1-3. *Gonatocerus alami* sp. nov., ♀ :
(1) antenna; (2) Fore wing; (3) Abdomen, in lateral view.

funicle segments 2-4 less than three times as long as wide.

Holotype ♀, INDIA: Uttar Pradesh, Aligarh, on grass, 15.8.1980 (*S. M. Shamim*).

This species is named after Prof. S. Mashhood Alam, in recognition of his contributions to our knowledge of insect morphology and taxonomy.

Gonatocerus aligarhensis sp. nov.
(Figs. 4-7)

FEMALE

G. aligarhensis sp. nov., resembles *G. alami* sp. nov., except in the following characters:

Antennae (fig. 4) Brownish; scape longer than following three segments together; pedicel as long as following two funicle segments together; funicle segments 1-4 subequal in length, each one and a half times as long as wide, fifth twice as long as wide; club slightly shorter than preceding four segments together.

Fore wings (fig. 5) with marginal fringe slightly more than one-half of wing width; legs brownish, basitarsi of fore legs (fig. 6) curved.

Abdomen (fig. 7) with ovipositor arising from basal one-third of abdominal venter.

Body length: 0.68 mm.

Comments: This new species is closely related to *G. alami* sp. nov., but differs by the characters given above.

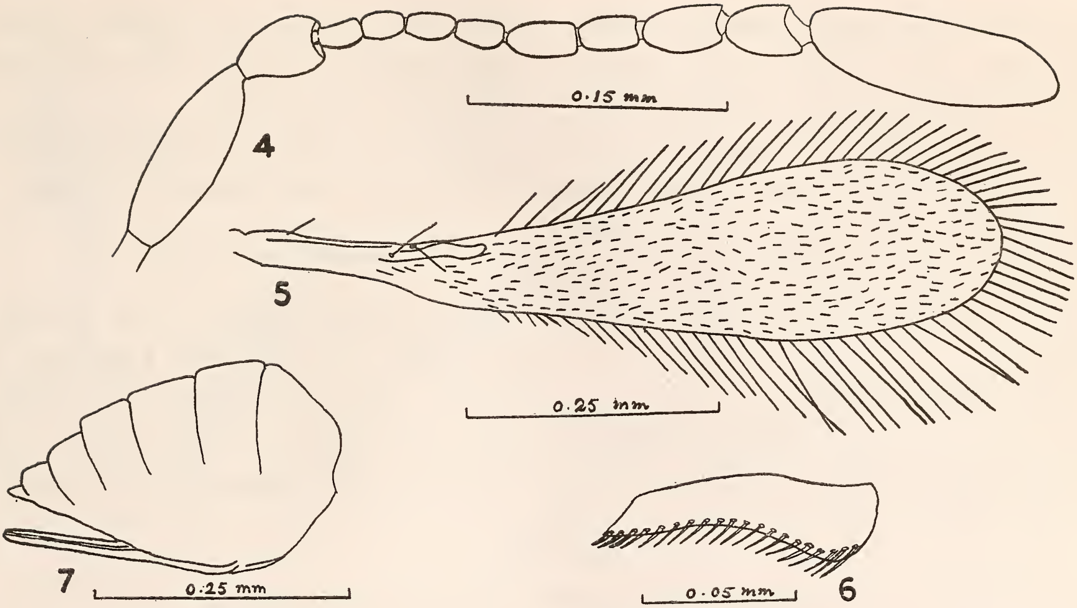
Holotype ♀, INDIA: Uttar Pradesh, Aligarh, 15.8.1980 (*S. M. Shamim*).

Gonatocerus terebrator sp. nov.
(Figs. 8-10)

FEMALE

G. terebrator sp. nov. resembles *G. alami* sp. nov. except in the following characters:

Antennae (fig. 8) brownish except radicle, scape and pedicel yellowish; first, fourth, fifth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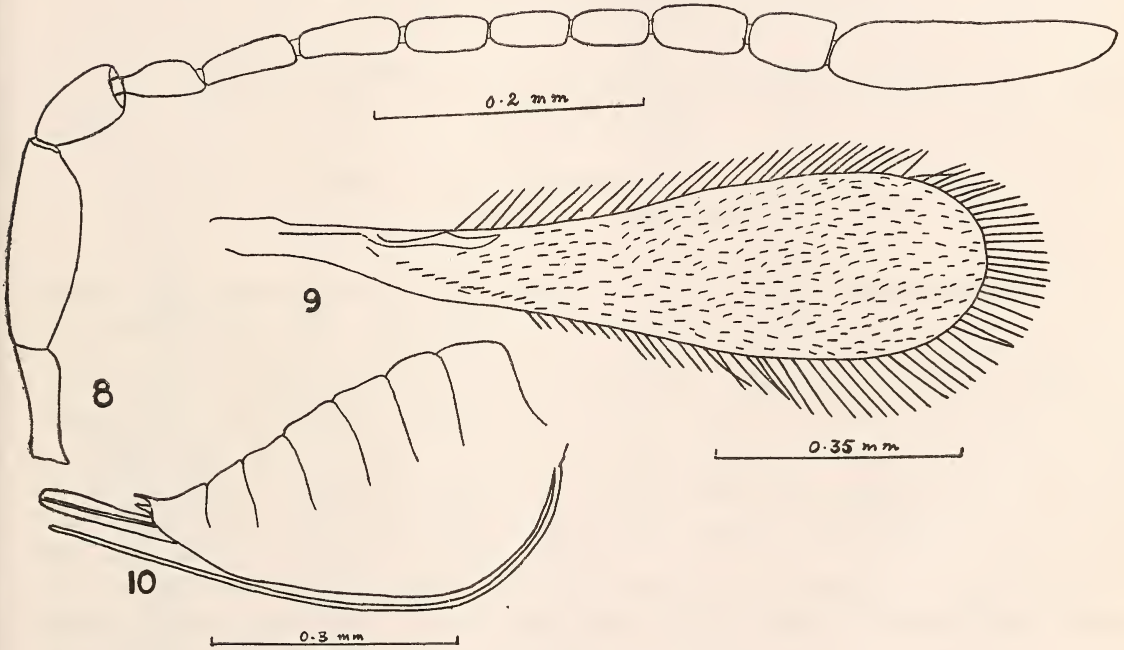
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Figs. 4-7. *Gonatocerus aligarhensis* sp. nov., ♀:
(4) Antenna; (5) Fore wing; (6) Basitarsus of fore leg; (7) Abdomen, in lateral view.

Figs. 8-10. *Gonatocerus terebrator* sp. nov., ♀:
(8) Antenna; (9) Fore wing; (10) Abdomen, in lateral view.

and sixth funicle segments subequal in length, each about twice as long as wide, segments second, third and seventh subequal in length; club four and a half times as long as wide, shorter than preceding four segments together.

Fore wings (fig. 9) with marginal fringe distinctly shorter than one-half the wing width.

Abdomen (fig. 10) brownish; distinctly longer than thorax; ovipositor exserted, exserted part of ovipositor one-fourth the length of abdomen.

Body length: 0.94 mm.

Comments: The new species is closely allied to *G. munnarus* Mani & Saraswat, 1973 but differs from it in having the scape shorter than pedicel and following two segments together, funicle segment first shorter than second, and sixth shorter than seventh.

Holotype ♀, INDIA: Uttar Pradesh, Aligarh, on grass, 15.8.1980 (*S. M. Shamim*).

Paratype ♀ (same data as for holotype).

ACKNOWLEDGEMENTS

We are deeply indebted to Prof. S. Mashhood Alam, the then Head, Department of Zoology, for providing necessary facilities. Thanks are also due to Prof. N. H. Khan, Chairman, Department of Zoology, Aligarh Muslim University, Aligarh for encouragement.

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DIMERIA KERALAE (POACEAE) — A NOVELTY FROM KERALA, INDIA[1]

N. C. NAIR, P. V. SREEKUMAR AND V. J. NAIR[2]

(With sixteen text-figures)

Dimeria keralae sp. nov.

Dimeria santapaui Almeida affinis, sed vaginis carinatis; racemis 2, inequalibus, intervolubilibus; spiculis parvioribus (*c.* 4.5 mm); callo longo, acute cuneato, indumento aureo; glumis parvioribus; gluma inferna apice alato; gluma supera non nisi apice alato; flosculo supero paleato, differt.

Annuals. Culms 10-30 cm tall, erect, slender, purplish; nodes bearded. Leaves 2-5 cm long and 1-2 mm broad, linear-lanceolate, glabrous or covered with a few tubercle-based hairs along the margins; mid rib prominent. Sheaths 2-6 cm, shorter than the internodes, keeled, loose, glabrous. Ligule a thin ovate membrane. Racemes 2, each 2-5 cm long, usually unequal and inter-wined. Rhachis *c.* 0.25 mm wide, flat on one side, angular on the other side, glabrous. Spikelets 4-5 mm long, oblanceolate, cuneate at base, distant and pedicelled. Pedicels 1-1.5 mm, joints extremely oblique. Callus 1-2 mm long, extremely acute at base, covered with golden — yellow hairs 1-1.5 mm long. Lower glumes 3.5-4 x 0.75-1 mm, oblong — linear, slightly emarginate and hyaline

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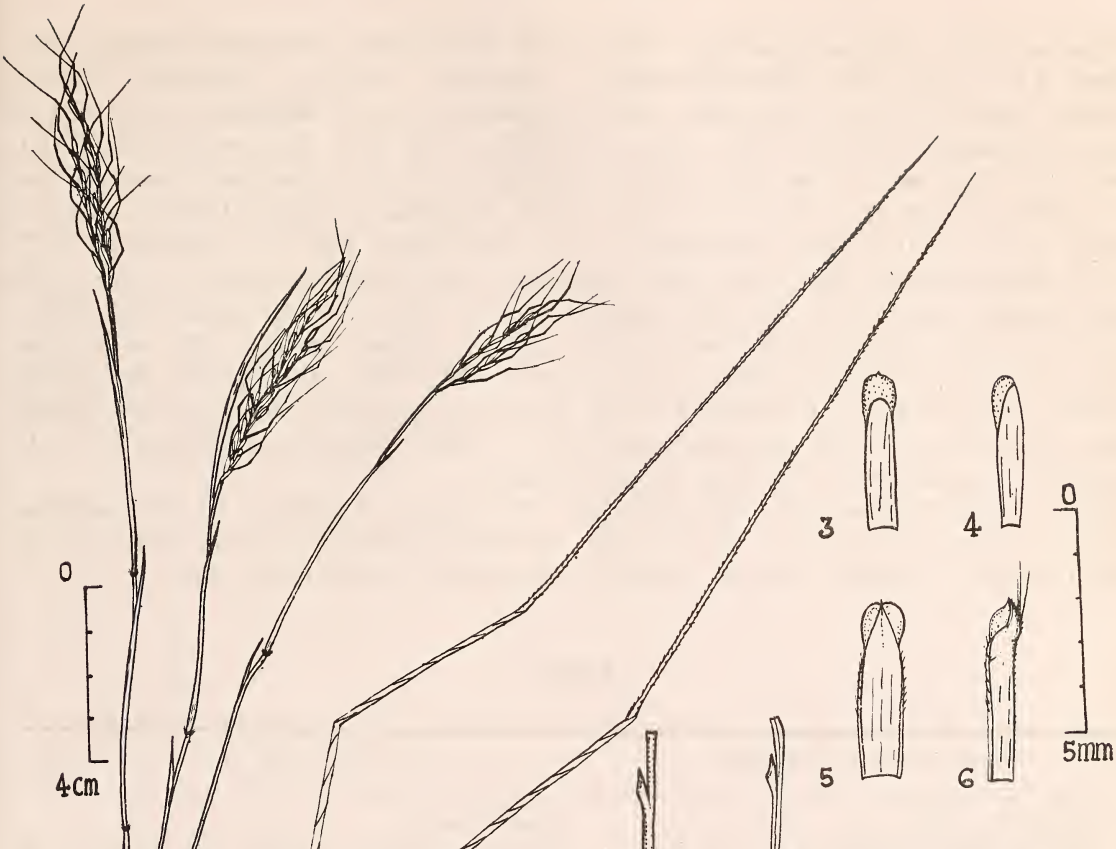
[1] Accepted September 1982.

[2] Botanical Survey of India, Coimbatore-641 003, India.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4mm

Figs. 1-16. *Dimeria keralae* sp. nov.

1. Plant; 2. Spikelet; 3. Lower glume — inner view; 4. Same — side view; 5. Upper glume — inner view; 6. Same — side view; 7. Rhachis — outer view; 8. Same — inner view; 9. Pedicel; 10. Upper lemma; 11. Lower lemma; 12. Upper palea; 13. Lodicule; 14. Stamen; 15. Pistil; 16. Grain with basally attached palea.

winged at apex, coriaceous, glabrous. Upper glumes 4-5 x 0.75-1 mm, oblong-lanceolate, minutely winged at apex, with hyaline wings along the margins which are hairy, and also with a few long hairs at the tip, coriaceous and glabrous elsewhere. Lower floret empty; lemma 3-4 x 0.3-0.5 mm, oblanceolate, 1-nerved, delicate, hyaline and ciliate along the upper margins; upper floret bisexual; lemma 3-4 x 0.75-1 mm, notched at apex, with a very long, stout awn in between, delicate and 1-nerved in the lower half, sub-coriaceous in the upper, glabrous; awn 20-30 mm long, stout, geniculate, column 10-15 mm long, twisted, chestnut brown, bristles pale and scabrid; palea very minute, 0.5-0.75 x 0.15-0.25 mm, ovate-lanceolate, nerveless, delicate, hyaline, shortly ciliate along the margins; lodicules 2, each *c.* 0.5 x 0.3 mm, obovate, 3 lobed at apex; stamens 2, anthers 1-1.5 mm long, pale-yellow with violet margins, filaments short; ovary *c.* 0.5 x 0.25 mm, elliptic, styles *c.* 0.5 mm long, slender, stigmas *c.* 1 mm long, narrow, pink, plumose; grain 2-2.5 x 0.4-0.5 mm, linear-oblong, with basally attached palea.

Holotype: KERALA. Cannanore District, Paramba, on way to Bandudka, ± 150 m, 16th October, 1981, *P. V. Sreekumar* 71717 (CAL). Isotypes in K, MH. *Paratypes*: Cannanore District, Paramba, on way to Bandudka, ± 150 m, 17th October, 1981, *P. V. Sreekumar* 71727; Periye, near the cashew project, ± 50 m, 18th October, 1981, *P. V. Sreekumar* 71755 (MH).

Fairly common in open, dry rocky grasslands along with other grasses like *Bhidea burnsiana* Bor, *Danthonidium gammiei* (Bhide) C. E. Hubb., and *Dimeria bialata* C. E. C. Fischer.

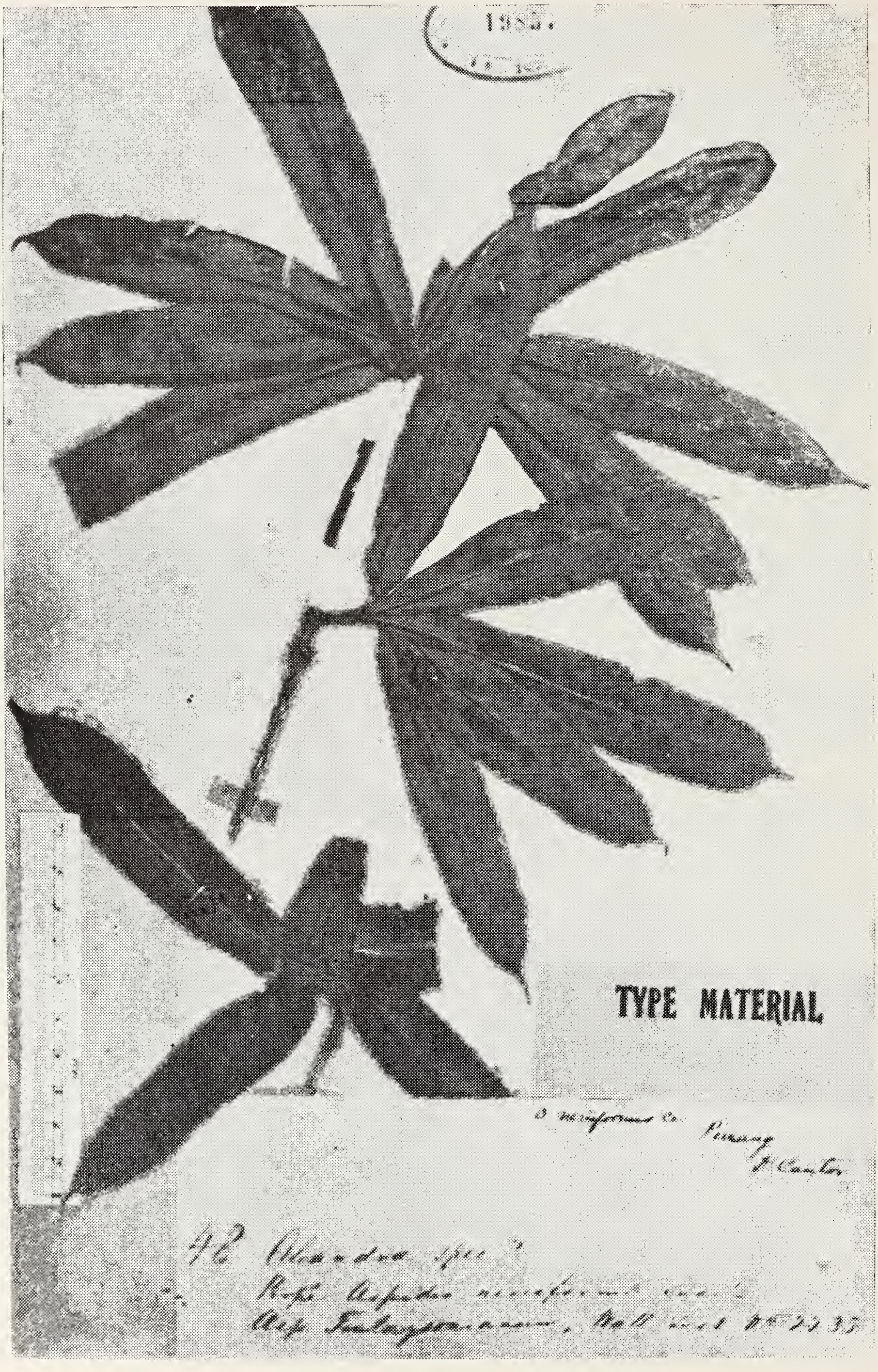
This species is allied to *Dimeria santapaui* Almeida but markedly differs from it in the characters as shown in the table.

TABLE

Dimeria santapaui Almeida	*Dimeria keralae* sp. nov.
1. Sheaths not keeled	Sheaths keeled
2. Raceme solitary, straight up to 2 cm long	Racemes 2, unequal in length, inter-twined, 3-5 cm long
3. Spikelets 2-7 in each raceme	Spikelets 8-10 in each raceme
4. Spikelets *c.* 7 mm long	Spikelets *c.* 4.5 mm long
5. Lower glumes 4-4.5 mm long, elliptic-acute, not winged at apex	Lower glumes 3-3.5 mm long, oblong-obtuse, with a hyaline wing at apex
6. Upper glumes *c.* 7 mm long, keels winged all along	Upper glumes *c.* 4.5 mm long, keels minutely winged at apex only and with a hyaline wing at the tip
7. Lower lemmas linear-acute	Lower lemmas oblanceolate
8. Upper floret epaleate	Upper floret paleate

Further, the species is quite distinct from all other species of the genus previously described from India, in the following characters:

1. Racemes are unequal in length and inter-twined with each other.
2. Both the lower and upper glumes possess hyaline wings at their tips.


TYPE MATERIAL
Penang
48 Oleandra spec ?

Oleandra malasianum sp. nov.

3. Callus is sharply acute, long and with golden yellow hairs.
4. Awns are long and stout, with a very long column.
5. Upper floret is paleate.
6. Grain is closely adpressed with the basal part of the palea, and it is very difficult to separate them.

ACKNOWLEDGEMENT

We are thankful to Dr. Thomas A. Cope of Herbarium — grasses, Royal Botanic Garden, Kew for kindly examining our specimens and for his opinion.

ON THE IDENTITY OF *ASPIDIUM FINLAYSONIANUM* WALL.[1]

S. R. GHOSH[2]

(*With a plate*)

Aspidium finlaysonianum Wall. Cat. 2235, 1829 is a nomen nudum. This passed off unnoticed till Christensen in his index (1906) pointed out with a note of interrogation that this taxon is identical with *Lastrea falcifera* Moore. Moore (1858) in his index has shown that this taxon is conspecific either with *Lastrea immersa* or with *Lastrea falcifera*.

During the course of a revisionary study on the genus *Oleandra* in Indian sub-continent, I came across Wallichian specimen bearing Accession No. 19857 housed in CAL herbarium with an annoted label on which Wallich himself had written in ink.

48. Oleandra spec. ?
Prope Aspidio nereiforme, Swartz.
Asp. finlaysonianum, Wall. List. n. 2235

On the right hand corner there is another notation.

O. nerriforme Cav. Penang. Dr. Cantor.

Christensen (1934, 1937) raised a doubt about the occurrence of *Oleandra nerriformis* in Malaysia and established that instead of this taxon, *O. pistillaris* (Sw.) C. Chr. occurred in Malaysia. From my study it is evident that *O. pistillaris* (Sw.) C. Chr. occurs in India instead of *O. nerriformis*. It may be assumed therefore that Wallichian taxon is synonymous with *O. pistillaris* (Sw.) C. Chr. Holttum (1954), while providing a description of *O. pistillaris* (Sw.) C. Chr., mentions two forms:

Form I: "Fronds hairless, sori usually very close to the midrib, stipes very stout".

Form II: "Fronds usually more or less hairy, sori in an uneven rows not close to midrib, stipe 1 cm long but often much shorter".

Close examination of the Wallichian specimen showed that the Wallichian material exactly corresponds to form II mentioned above. I am of the opinion that it is a distinct species which has some other distinctive characters mentioned under key given below:

In view of above observation and as the Wallichian taxon is nomen nudum, a new name is proposed with detailed description including latin diagnosis. A key to differentiate it from

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[1] Accepted September 1982.

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Oleandra pistillaris (Sw.) C. Chr. is also provided in this paper.

KEY TO TAXA

Lamina oblong, profusely hairy on lower surface, margin of rhizome scale profusely hairy, sori in irregular row...............*Oleandra malasianum*

Lamina linear-lanceolate, glabrous on lower surface, margin of rhizome scale nearly entire and glabrous, sori in regular row....*Oleandra pistillaris*

Oleandra malasianum sp. nov.

Synonym: *Aspidium finlaysonianum* Wall. list. n. 2235

Rhizoma rigidum, cylindricum, 3-5 mm, crassum, erectum, scandens, ramosum, squamis adpressis imbricatis dense tectum, squama caule peltifixa, in superficie rhizomatis sulcum formans, fuscata, lanceolata, 4-6 mm longa, 1-1.5 mm lata ad partem basalem, ad marginem profuse pilosa. Frondes in verticillis, 5-7 cm distantibus; Phyllopodia 2-3 mm longa, stipes phyllopodia articulatus, 2-5 mm longus, brunneus, dorsaliter sulcatus rotundatus. Lamina coriacea simplex, integra, oblonga, apices cordato acuminata, costa prominense superficie abaxiali sulcata superficie adaxiali, profuse pilosa infra. Venae liberae, bis vel ter furcatae, parallae, terminatae in hydathodis in serie dispositis prope marginem. Sorus solitarius indusiatus, positus in venas laterales, seriem irregularem in castae utrumque latera formans. Indusium ad margineum integrum. Sporae monoletae.

Rhizome stiff, cylindrical, 3-5 mm thick, erect, scandent, branched, densely covered with imbricate adpressed scale, scale peltifixed with the stem leaving a groove in rhizome surface, dark, lanceolate 4-6 mm long, 1-1.5 mm wide at basal portion, scale margin profusely hairy. Fronds are in whorl, each whorl is separated by 5-7 cm. Phyllopodia 2-3 mm long, stipe articulated to phyllopodium, 2-5 mm long, brown, dorsally grooved, rounded; lamina simple, entire, oblong, apex cordato-acuminate; midrib raised on abaxial surface, grooved in adaxial side; texture coriaceous, profusely hairy on lower surface. Veins free, twice or thrice forked, parallel, ends in hydathodes which are arranged in a row near margin. Sori solitary, indusiate, situated on the lateral veins forming a irregular row on either side of the midrib, margin of indusium entire; spores monolete.

Type: Penang, Malayasia, Wall. Cat. n. 2235 (Acc. no. 19857 — CAL).

ACKNOWLEDGEMENT

I am very grateful to Dr. N. C. Mazumdar, Systematic Botanist, Central National Herbarium, Botanical Survey of India for the latin translations of the description.

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MISCELLANEOUS NOTES

1. SOME OBSERVATIONS ON ANTLER CYCLE OF HOG-DEER (*AXIS PORCINUS*) IN CAPTIVITY

This communication presents data on antler cycle of Hog-Deer observed at Nandankanan Biological Park, Orissa during the period October, 1970 to March, 1983. The number of Hog-Deer stags under observation varied from one to four.

Period of antler casting

During the observation period twenty antler castings (single spike as well as branched) were recorded during a six month period from October to March as follows: October, 2; November, 1; December, 1; January, 9; February, 6; and March, 1. Peak antler casting (85%) was recorded during winter months (November-February).

Both antlers were cast either in one day or within five days. Casting of antlers of both sides was completed on one day in eight instances (40%), on two consecutive days in six instances (30%), within three days in three instances (15%), within four days in two instances (10%) and within five days in one instance (5%).

According to Asdell (1964) the antlers of this species are shed in April in India but in the Philadelphia Zoo there is a record of a February shedding and in the Washington Zoo there is a record of July shedding. The majority of Hog-Deer of Dhikala, Corbett National Park cast their antlers from February to May (Tak and Lamba 1981). Acharjyo (1971) reports three instances of a stag shedding its antlers in December. He further states that both the right and left antlers were always shed the same day.

Period of velvet rubbing

As usual with the other species of Indian deer, the Hog-Deer stags rub off the velvet of antlers soon after their growth is completed. The nineteen observations on velvet rubbing were recorded as follows: February, 3; March, 1; April, 6; May, 4; June, 1; July, 1; November, 1; and December, 2. The majority of stags (63.16%) cleared their velvet during summer months (March-June).

The Hog-Deer stags remove velvet during May-August and hard antlers were retained from August-January at Dhikala, Corbett National park (Tak and Lamba, loc. cit.).

Time taken for antler growth

Observations on the period required from the time of casting of antlers to the time when the stag starts rubbing off the velvet is taken as the span of antler growth. This period observed in twelve instances varies from 3 to 4 months (3 months in 4 occasions, 3½ months in 5 occasions and 4 months in 3 occasions).

Age at first antler casting

Two male Hog-Deer born in the Park in December, 1981 (7.12.1981 and 17.12.1981), started showing knob like pedicels by the end of July, 1982 and rubbed off the velvet in the second fortnight of December, 1982. Casting of single spike antlers in these two specimens were recorded in the last week of February, 1983. As expected the coronet or burr was absent in single spike antlers.

These observations suggest that the knob like pedicels appear at the age of approximately seven months, rubbing off the velvet starts at the age of about one year and casting of the first set of single spike antlers occurs at the age of about 1 year and 2½ months.

CASTING INTERVAL

The casting interval observed in seven instances among four specimens varies from 338 to 375 days. The stags cast their antlers annually.

The casting interval reported twice in a stag was 347 and 383 days (Acharjyo, loc. cit.).

SIZE AND WEIGHT OF CAST ANTLERS

Three of the cast single spike antlers measured (weighed) as follows: 6 cm (13.250 gm); 7.5 cm (16.500 gm) and 9 cm (23.200 gm). Maximum length of cast antlers on the outside curve recorded twice was 43 cm each. The maximum weight of two cast antlers of a stag recorded once was 271 gm (right) and 260 gm (left).

The average horns of Indian Hog-Deer measure 30 to 38 cm but the Burmese stags carry antlers upto 61 cm (Prater 1971).

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April 11, 1983.

S. K. PATNAIK

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2. A NOTE ON THE LONGEVITY AND FERTILITY OF THE BLACKBUCK, *ANTILOPE CERVICAPRA* (LINNAEUS)

During my tenure as District Forest Officer of Vellore Division in North Arcot District of Tamil Nadu, in response to my usual questions about animals, birds, ancient temple ruins, forts etc; inside reserved forests, a Forest Watcher replied that in his jurisdiction there were three deer like animals without horns and without spots in the Alliyalamangalam Reserved Forest. He also added that they were there for nearly 20 years and that there were no signs of young ones. He had not seen them himself but that was what he had heard from a villager in that locality. This happened in mid 1967.

The next day being curious to see the animals I took with me this watcher, the forest guard and a man of that locality who had seen these three animals and was familiar with the isolated forest block. The Alliyalamangalam Reserved Forest lies 145 km south west of Madras and 25 km south east of Polur in North Arcot district. Its total area is 3043.27 ha, of which, 1970 ha remains even today planted up with hybrid Eucalyptus and the rest holds a natural scrub forest of thorny bushes and short trees thriving under an annual rainfall of about 500 mm. The reserve is practically a level country of red soil, the unplanted portion being hard stony soil with a small rounded hillock at one end. Close to the foot of the hillock runs the reserve boundary, beyond which is a vast stretch of dry cultivated lands, except for civets, mongoose, jungle cat and jackal there were no other carnivores; deer were also absent in that reserve.

As we approached the hillock by jeep through the reserve forest, we were cautioned that the three animals normally rested at the foot of the hillock and would run to the cultivated open lands at the sight of jeep or man. That is what happened when our jeep was 200 metres from the foot of the hillock, when out dashed three blackbuck adult females racing across the vast expanse of cultivated lands which had no crops at that time. The following day also the same thing happened and the three blackbuck adult females alone were to be seen. The nearest village and habitation from that spot was about two kilometres away where I learnt that in the nineteen thirties and forties, when the whole reserve was a natural thorn forest, the population of blackbuck was about 150 to 200 and that during world war II both Indian and foreign army personnel used to come in jeeps for shikar, shoot and take away even upto three at a time and that the present three blackbuck females were the only animals left over from the original stock. The three blackbuck still associated jeep and man with war time killings, a memory that enabled them to survive all these years. Assuming that, even though war ended in 1946, the same poaching would have continued till 1950, it would be reasonable to deduce that these three blackbuck females went without a male from 1950. I came into the scene in mid 1967.

With a view to rebuilding the blackbuck population in that reserve I got an adult male and female from Guindy Park Reserved Forest in Madras during November-December 1967 and released them near the hillock; the female died in a couple of days due most probably to injury sustained during capture and transport; the male being unafraid of man strayed a few days later into another nearby village where it was promptly killed and shared. Later, in 1968 November-December I got another adult male and female from Guindy Park Reserved Forest and released them near the hillock. I also took pains to visit the nearby villages and do propaganda about the introduction of the pair to the company of the remnant three and mustered their support to protect the blackbuck. The villagers got enthusiastic and assured me that they would see that no poacher was allowed to shoot, which promise they have kept up even today. I understand. Soon after that I left Vellore on transfer.

In 1973 when I was touring in Vellore division as Conservator of Forests I had the blackbuck population counted by the Rangers and Foresters as news came that they had multiplied. The count came to 11 animals. After that I lost track of the population there till June 1982 when the present Chief Wildlife Warden (Mr. K. Shanmuganathan) took the trouble to have the blackbuck counted and informed me in particular that there were 92 animals in Alliyalamangalam Reserved Forest.

When I mentioned this interesting experience to Dr. Rauf Ali, formerly of the Bombay Natural History Society and Indian Institute of Science, Bangalore, he suggested that I report this to you for record and publication as it is a useful information on the longevity and fertility of blackbuck under natural conditions. It was nearly 14 years since an adult male was added to the original three females. Of course another female was also introduced with the male as already mentioned. Now two points come up for consideration. Firstly, from 1950 to 1968, over a period of atleast 15 years the three females had gone without a male and in 1968 when I introduced the male I had doubted if they would be fertile. But contrary to my misgivings they had remained fertile and readily multiplied. Secondly, this seems to be the only authentic record of three blackbuck females living for at least 15 years under natural conditions.

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Chetpet,
Madras 600 031,
March 29, 1983.

G. J. RAJASINGH

3. HORN GROWTH IN BLACKBUCK

(*With a text-figure*)

While techniques such as tooth-eruption, replacement, and wear help estimation of age of mammals to the accuracy of months, for their age determination in the field, a biologist too often will be content with age categories such as fawn, adolescent, sub-adult, adult, and old. The growth of antlers in deer such as barasingha (Martin 1977) and horn growth in sheep (Taber 1971) and blackbuck (Mungall 1978) were used as criteria for age estimation in the field. The horn growth of a blackbuck fawn, *Kiran,* which was observed for a period of 2 years and 3 months since its birth is presented in this paper.

A fawn of 3-4 days old was captured by a cultivator of Kolpur village in Mahabubnagar District of Andhra Pradesh from jowar fields on 19-2-1978. This fawn, *Kiran,* after being tamed for over 3 months by him, was brought to the well fenced Mahavir Harin Vanasthali Blackbuck Sanctuary in Hyderabad by the D.F.O. (Wildlife) of Achampet on 2-6-1978. From then onwards its horn growth was observed through 4-4-1980. The horn length was measured straight from the base to its tip. The number of rings added in the horn since the previous observation was also recorded. Further records could not be made as the animal died.

Results

The addition of rings in the horns over a period of time is shown in fig. 1. Till it was 5 months old there was no sign of horn growth. Later bumps appeared on the head which were

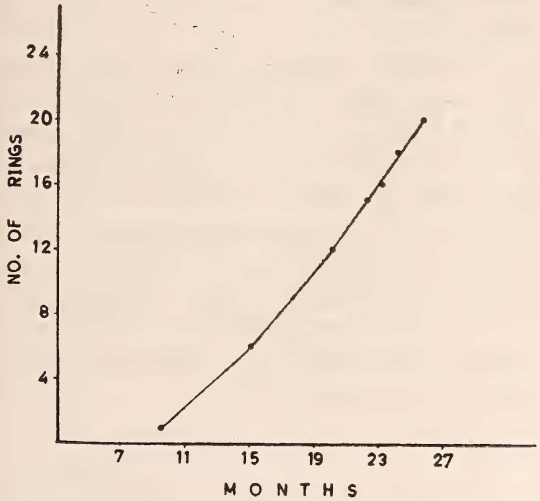

Fig. 1: Horn development in *KIRAN* as an index of age.

the first indications of horn development. When it completed 8 months, it had the first ring and the horns measured 3 cm. From then onwards, an average of 0.75 ring/month was added till the age of 15 months. At this stage the first spiral was complete with 6 rings and the horns were 15 cm long, the left horn being slightly longer than the right. The average of horn length till that time was 1.5 cm/month. For the next six rings it took only 5 months — an average of 1.2 rings/month and the average horn growth rate 2.0 cm/month. During the next 5 months on an average 1.60 rings were added per month. The growth rate during this period showed an increase of 1.8 cm/month. By this time the age was 25 months and the second spiral was complete which earned 14 rings. The total horn length was 34 cm, the left horn 0.5 cm longer than the right.

The horn growth pattern is comparable to that of the horn growth of blackbuck described by Mungall (1978) for the Texas population, which also showed two complete spirals at the age of 2 years. The present study, though there is lack of sufficient data, suggests that the number of rings in the horns would probably help better in the estimation of age as against the number of spirals.

ACKNOWLEDGEMENTS

I am grateful to the Andhra Pradesh State Forest Department, particularly Shri D. S. Ganga Khedkar, DFO (Wildlife), for the cooperation and interest shown, and to Prof. J. V. Ramana Rao, Osmania University, for his encouragement in this study. Thanks are due to President, FRI & Colleges, Dehra Dun, for providing a Junior Research Fellowship.

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4. A NOTE ON THE LONGEVITY OF TWO SPECIES OF INDIAN OTTERS IN CAPTIVITY

An adult female Common Otter (*Lutra lutra*) and one adult male Smooth Indian Otter (*Lutra perspicillata*) were received at the Nandankanan Biological Park, Orissa on 6. iii. 1965 and were exhibited together in a somewhat circular enclosure having a floor space of approximately 71 square metres. Half of this enclosure is occupied by a 60 cm deep water pool. Each Otter was fed with one kilogram of fresh water fish daily but once a week on Mondays only 500 grams of fish was fed.

The female Common Otter (*Lutra lutra*) died accidentally on 5-x-1979 after remaining for 14 years and 7 months in captivity. The estimated age at the time of death was about 17 years.

The male Smooth Indian Otter (*Lutra perspicillata*) died on 18-ii-1982 after remaining for 17 years 9 months and 13 days in captivity. The estimated age at the time of death was about 20 years.

River Otters (*Lutra* sp.) have lived for 19 years in captivity (Walker *et al.* 1964). The greatest longevity of the Eurasian Otter (*Lutra lutra*) recorded in the Zoological Gardens of Basel was 11 years, 2 months and 23 days (Flower 1931). A specimen of *Lutra vulgaris* (= *lutra*) was still living on January 12, 1943 in the Trivandrum Zoological Gardens, after 22 years in the collection (Simon 1943). The longevity of Smooth Indian Otter has not been given by Crandall (1965).

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5. SLOTH BEAR'S (*MELURSUS URSINUS*) METHOD OF HUNTING FOR TERMITE NESTS

I have been acquainted with a female sloth bear (*Melursus ursinus*) and its cub — now a sub-adult, off and on, for about a year now. The area where these animals have been operating is the North Eastern Section of the lower plateau of the Nilgiris; the Sigur Forest Range. This is a dry belt where the rain fall is scanty and the type of forest is scrub. Precipitation comes from the N.E. as well as the S.W. monsoons, but the area is at the tail end of both; and summer showers. The bears are seen most often in winter when the *Zizyphus* is in fruit and during the rains.

The pre-monsoon showers were late in coming this year (1983). When the first showers fell in the middle of May the bears started coming out regularly hunting for termites. During the first diggings they seldom got to the termite nests except along the banks of the Sigur River where it was comparatively moist. The mother bear did most of the serious digging. In spite of the poor ratio of success the bear continued to open up the ground, wherever it suspected termite nests lying below — including about a dozen holes in our property all within a radius of one km. At first this seemed to be a random digging spree. Most of the termite nests had no mounds over them but were in the pre-mound stage flush with the ground, only a small hole showing. Only a bear would know that these were termite holes. These were mostly in the open where the ground was hard and rain water drained quickly. These diggings were not deep but extended just as far as the moist earth would allow without much effort. Many of these holes were deepened and enlarged as and when it rained. The bears did not spend much time at these holes even when there was a prospect of finding a termite nest, say, 20 cms away. They were in a hurry, literally on the run, all the time they were abroad. They were usually out by 1600 hours and some times did not retire until 0700 or 0730 hours. As rain continued to fall the bears were more successful. They were able to dig out termite nests whole, usually at depths ranging from 25 to 40 cms. Their droppings during this period were composed almost entirely of termite remains and earth. Being the honey season, they probably robbed a few bee hives as well.

It may be mentioned that sightings as well as tracks showed that these were the only bears in the area, occasionally joined by a large aggressive male bear. The observation extended over a 4 week period from the middle of May. During this period fairly heavy rain fell on 4 days, moderate showers on 6 days and light showers and drizzle on 6 days.

It began to dawn on me that what initially seemed to be a mad act had a method to it. The adult bear was deliberately employing the strategy of making the rain aid its digging efforts, just as a gardener when trying to dig a pit in hard ground would make a small trial pit, pour water to soak the ground; dig a little deeper and pour more water and repeat the process until the desired depth is reached. Or am I crediting the bear with human intelligence — of distinguishing cause and effect? Quite possibly bears have the ability to reason.

E.R.C. DAVIDAR

"CHEETAL WALK",
MASINIGUDI,
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June 15, 1983.

6. ADDITIONS "TO THE BIRDS OF GOA BY ROBERT B. GRUBH & SALIM ALI JBNHS — VOL. 73, NO. 1"

I had the opportunity to visit the forests of Goa, thrice during the last year, with a few members of the Bombay Natural History Society and World Wildlife Fund — India. A brief survey of the flora and fauna of the region was made during these visits which covered the periods from 1) 18th to 24th May 1981, 2) 6th to 10th April 1982, 3) 16th to 22nd June 1982. All these three visits were confined to the localities of Castlerock — Dudhsagar, Molem, Bondla and Mayem lake. Though the Castlerock — Anmod region is on the border of Goa, my notes here strictly adhere to the geographical Goa region. A total of 162 species of birds were recorded. The following list consists of the species not recorded in the BNHS ornithological survey in November-December 1972.

WILDLIFE

Contrary to the report of the BNHS survey of 1972, we recorded the following:

1) Giant squirrel — *Ratufa indica* (Erxleben)
Noted: Dudhsagar, Molem, Bondla.
2) Five-triped palm squirrel — *Funambulus pennanti* Wroughton.
Noted: Molem.
3) Common Indian langur — *Presbytis entellus* (Dufresne)
Noted: Dudhsagar, Molem.
4) Bonnet monkey — *Macaca radiata* (Geoffroy)
Noted: Molem, Bondla.
5) Striped hyena — *Hyaena hyaena* (Linnaeus)
Noted: Molem.
6) Barking deer — *Muntiacus muntjak* (Zimmermann)
Noted: Molem, Bondla.
7) Jackal — *Canis aureus* Linnaeus
Noted: Molem.
8) Wild boar — *Sus scrofa* Linnaeus
Noted: Molem.

In addition to these, flying lizards (*Draco dussumieri*) at Molem, a checkered keelback (*Xenochrophis piscator*) and a common wolf snake (*Lycodon aulicus*) were observed at Bondla.

Whitebreasted laughing thrushes were recorded at Dudhsagar during the second visit. These birds were also found in large parties of 30 to 40 at Castlerock. This is being noted here because in the *BNHS* survey report, the absence of this bird is specifically mentioned.

Rosy minivets were seen at Molem during the first and second visits. It would be interesting to determine whether these birds regularly overwinter in Goa or if there is any record of breeding.

SYSTEMATIC LIST

1. *Ardeola striatus* (Linné). Little Green Heron
Noted: Panaji.
2. *Ciconia episcopus* (Boddaert). Whitenecked Stork
Noted: Molem.
3. *Accipiter virgatus* (Temminck). Besra Sparrow-hawk
Noted: Molem.
4. *Perdicula asiatica* (Latham). Jungle Bush Quail
Noted: Mayem.
5. *Pavo cristatus* Linné. Common Peafowl
Noted: Molem, Bondla.
6. *Treron phoenicoptera* (Latham). Green Pigeon
Noted: Bondla.

7. *Ducula badia* (Jerdon). Jerdon's or Southern Maroonbacked Imperial Pigeon
Noted: Bondla.
8. *Streptopelia decaocto* (Frivaldszky). Indian Ring Dove
Noted: Bondla.
9. *Streptopelia chinensis* (Scopoli). Spotted Dove
Noted: Molem, Bondla.
10. *Cuculus varius* Vahl. Common Hawk-cuckoo
Noted: Molem, Bondla, Mayem.
11. *Cacomantis sonneratii* (Latham). Indian Bay banded Cuckoo
Noted: Molem.
12. *Cacomantis passerinus* (Vahl). Indian Plaintive Cuckoo
Noted: Molem.
13. *Surniculus lugubris* (Horsfield). Drongo-cuckoo
Noted: Bondla, Molem.
14. *Apus affinis* (J. E. Gray). House Swift
Noted: Molem, Panaji.
15. *Ceyx erithacus* (Linné). Threetoed Kingfisher
Noted: Colem, Molem.
16. *Picus chlorolophus* Vieillot. Small Yellow-naped Woodpecker
Noted: Dudhsagar.
17. *Picoides mahrattensis* (Latham). Yellow-fronted Pied Woodpecker
Noted: Molem, Bondla.
18. *Pitta brachyura* (Linné). Indian Pitta
Noted: Bondla, Mayem.
19. *Hirundo concolor* Sykes. Dusky Crag Martin
Noted: Panaji.
20. *Hirundo smithii* Leach. Wiretailed Swallow
Noted: Panaji, Mayem.
21. *Artamus fuscus* Vieillot. Ashy Swallo-shrike
Noted: Molem.
22. *Sturnus erythropygius* (Blyth). White-headed Myna
Noted: Molem.
23. *Gracula religiosa* Linné. Hill Myna
Noted: Dudhsagar, Colem.
24. *Garrulax jerdoni* Blyth. Whitebreasted Laughing Thrush
Noted: Dudhsagar.
25. *Rhipidura albicollis* (Vieillot). White-throated Fantail Flycatcher
Noted: Bondla, Mayem.
26. *Sylvia curruca* (Linné). Lesser White-throat
Noted: Bondla.
27. *Saxicola caprata* (Linné). Pied Bushchat
Noted: Panaji, Mayem.
28. *Parus major* Linné. Grey tit
Noted: Bondla.
29. *Parus xanthogenys* Vigors. Yellowcheeked Tit
Noted: Molem, Bondla.
30. *Sitta castanea* Lesson. Chestnutbellied Nuthatch
Noted: Molem.
31. *Nectarinia lotenia* (Linné). Loten's Sunbird
Noted: Bondla.
32. *Aethopyga siparaja* (Raffles). Yellow-backed Sunbird
Noted: Bondla, Mayem.
33. *Zosterops palpebrosa* (Temminck). White-eye
Noted: Bondla.

ACKNOWLEDGEMENTS

I am thankful to Mr. Nosherwan Sethna and Miss Renee Borges who accompanied me on these treks and helped in identification of birds.

ULHAS RANE

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August 14 1982.

7. OCCURRENCE OF THE BLACK TERN *CHLIDONIAS NIGER* (LINN.) IN INDIA

In 1950 Horace Alexander (*JBNHS* 49, pp. 120/121) published the first record of a Black Tern *Chlidonias niger* (Linn.) from India being one seen at Delhi. In subsequent literature (Ripley's SYNOPSIS 1961 and 1982, INDIAN HANDBOOK 1969 and 1981), this sighting has been considered the only record from our limits and as such to be treated with caution.

Accordingly, Humayun Abdulali in Checklist of the Birds of Delhi, Agra and Bharatpur (1978) marked it for Delhi only and was surprised to see it included in a list of birds of Bharatpur published by the Chief Wildlife Warden for Rajasthan at Jaipur, and now being sold at Bharatpur.

As the only possibility appeared to be its inclusion in the BNHS Bird ringing records for this area, these were examined but with no positive result. VCA however drew attention to correspondence wherein on 7th December 1970, P. B. Shekar, the Society's Field Assistant, telegraphed from Point Calimere, Dist. Thanjavur, Tamil Nadu, 10°18′N; 79°51′ E, that a tern bearing Moscow ring marked Moskwa F-140.956 had been obtained. The U.S.S.R. Academy of Sciences by their letter No. 3450 dated 19th January 1972 said it had been placed on a juvenile *Chlidonias niger* at Artek, Krasnovodkii, Turkmen S.S.R., 37.21 N, 53.56 E, on 18th July 1970, definitely establishing the occurrence of the species in India.

As no information is available in Indian literature regarding this species it may be mentioned that the bird had its wing measured as 221 mm. and weighed 72 gms. The weight is slightly over that noted in BIRDS OF THE SOVIET UNION (1969, Vol. 3:627), i.e. gms *contra* 52.8 to 67.8 gm.

This is an important record permitting acceptance of the earlier sight record and we are writing this note for it appears to have escaped attention and has remained unpublished.

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April 20, 1982.

8. OCCURRENCE OF LESSER FLORICAN (*SYPHEOTIDES INDICA*) IN KANHA NATIONAL PARK

Lesser florican is found during the monsoon months in the drier parts of Gujarat, Rajasthan and western M.P. where suitable grasslands exist. The Bengal florican (*Eupoditis bengalensis*) occurs in the riverine grasslands from Assam westwards to the terai areas of U.P. Sálim Ali and Ripley mention their having been reported as far east as the Teesta River in Bengal, but all such occurrences have been in the Gangetic valley. I have not come across any report of the lesser florican in Madhya Pradesh east of Bhopal.

In June 1969 I saw a female lesser florican on the Kanheri Maidan in the Kanha National Park. The grass was short and turning green with the pre-monsoon showers.

On 21-5-71 I saw another female lesser florican practically on the same spot. It was disturbed by some blackbuck moving away from my jeep. I had very clear views of it and took a movie of it, putting it up altogether six times. As male lesser florican change to their nuptial plumage about this time, I was very keen to ascertain whether it was a male that was undergoing transformation, or was indeed a female. It did not have the tell-tale head plumes and was obviously a female. It was also clear that it was not a female of the Bengal florican. The bird was not sulking and was in fact fairly confiding, as these birds often are when they first appear at the onset of the monsoon.

The purpose of writing this note is to elucidate information from the editors and readers whether there has been any record of the lesser florican in Central India as far east as the Kanha National Park in the Mandla district of Madhya Pradesh.

M. K. RANJITSINH

SECRETARY TO GOVERNMENT,
MADHYA PRADESH,
FOREST DEPARTMENT,
BHOPAL, M. P.
August 6, 1982.

9. UNUSUAL ADOPTION BY TAILOR BIRDS (*ORTHOTOMUS SUTORIUS* PENNANT)

A pair of tailor birds resident in my friend Dr. Salvi's garden at Parel has been under our observation for the last two years.

In August 1980, a peculiar nest was seen in this garden on a *Gardenia* tree. The fibre cup nest was not completely covered with leaves but though apparently not complete, the female laid three eggs and started incubating. After a few days, the nest was abandoned probably because the birds were disturbed by some children.

The pair was always seen moving around the same garden, hopping amongst *Thunbergia* creepers, feeding on the nectar of *Lantana* flowers and insects. Dr. Salvi got quite interested in this pair and everyday in the early morning, while watering the garden, he kept a watch on the pair still roosting. It was found that the pair had become permanent residents of the garden and every night the birds roosted in the same *Gardenia* tree, almost on the same branch.

On the 2nd of November 1981, some boys pulled down a tailor bird's nest with two chicks from a Tagar (*Ervatamia coronaria,* Stapf) bush near a building about 500 metres away from Dr. Salvi's garden. There are three lanes and eight buildings in between these two places. The boys brought this nest with the chicks which looked about a week old, to us. Not knowing what to do, we tied this nest with the chicks in it, at the same place in the *Gardenia* tree, where the tailor birds had been found nesting last year.

We kept watch on the nest and to our surprise and pleasure, found that the birds took interest in these chicks. Initially they watched the chicks from close quarters. Next day we found that the pair had adopted these orphaned chicks and both male and female were feeding them with insects.

Unfortunately the next day, one of the chicks was found dead due to an unknown cause. The pair however continued to look after the remaining chick successfully. On the 11th day both the foster parents were seen teaching it to fly and after two days the bird embarked on its first solo flight.

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G. D. AMBEKAR MARG,
BHOIWADA, PAREL,
BOMBAY 400 012,
April 15, 1982.

ULHAS RANE

10. COMMUNAL USE OF VILLAGE PONDS BY THE MUGGER CROCODILE (*CROCODYLUS PALUSTRIS*), CATTLE AND MAN

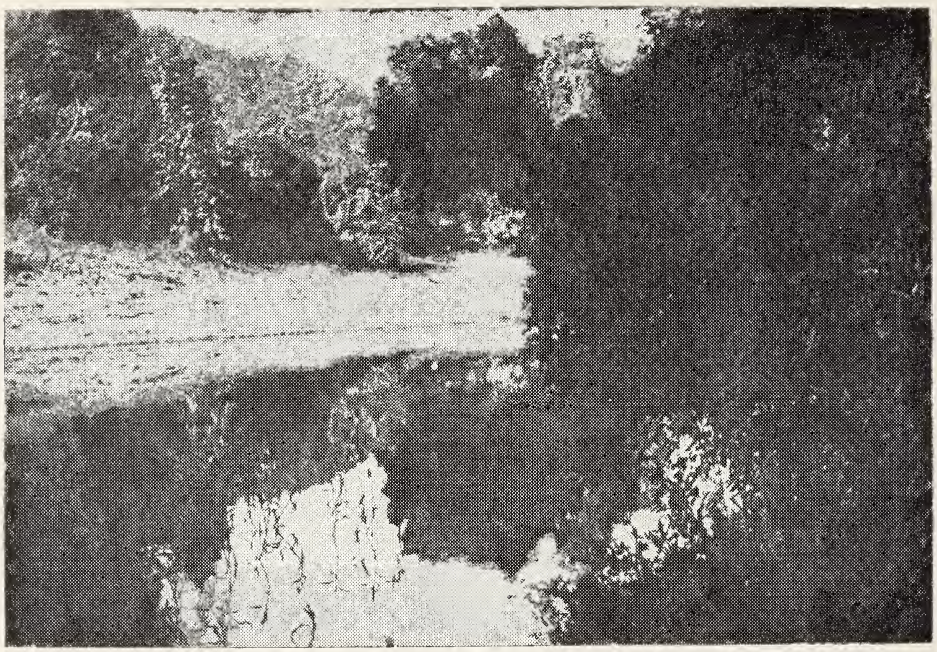
(*With a plate*)

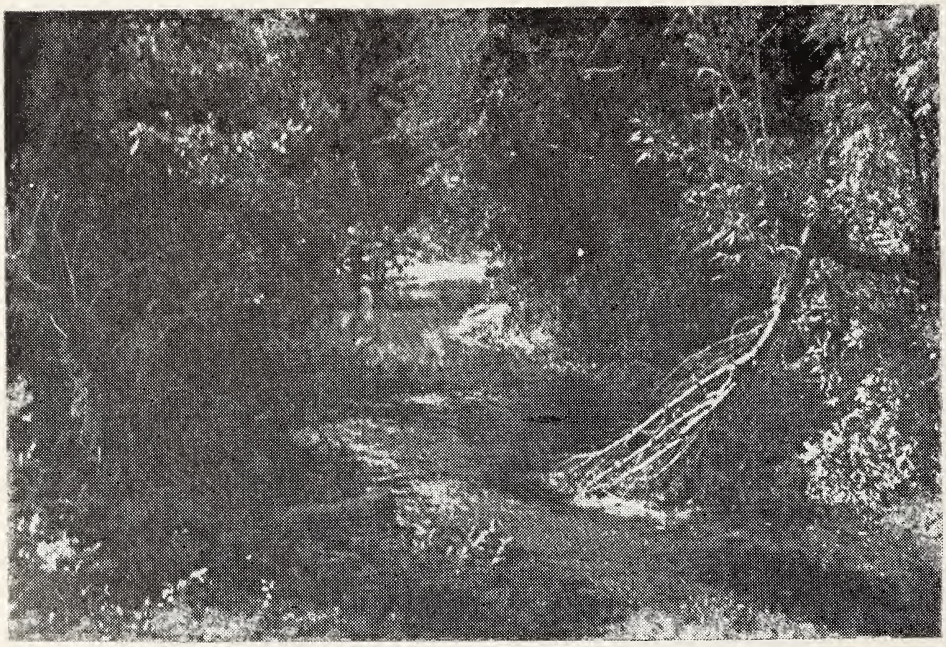
INTRODUCTION

In contradiction to the common and unauthenticated belief, there are several instances in record indicating that the mugger (*C. palustris*) is a docile crocodile, leading, when allowed to do so, a friendly and peaceful coexistence with both cattle and man.

Bustard (1974) and Whitaker (1974) mentioned about the mugger's coexistence at the Killikudu reservoir in Tamilnadu. Acharjyo and Mohapatra (1978) have recorded that a mugger which escaped from the Nandankanan Biological Park, Orissa stayed in the zoo's lake which, at its periphery, is used by villagers and their cattle.

Further evidence of the innocuous nature of the species is provided by the various accounts of crocodile worship (B. C. Choudhury, pers comm., Guggisberg 1972, Singh, L.A.K., in lit.) where mugger worship is often symbolised as a sign of veneration to Goddess Ganga or God Vishnu. The most remarkable were the mugger of 'Mugger Pir' in Pakistan. Andrew Leith Adams (1860), giving an account of the Mugger Pir wrote, "... The largest crocodile lives in a long, narrow tank separated from the others. The Fakirs and natives who worship in the neighbouring temples had painted his forehead red — they venerate the monster, making a salamn to his majesty whenever he shows himself above water...". It should be noted that the mug-





Above: The village pond at Beherasahi during April (Case I)
Below: One of the two connections of the above pond with the River Mahanadi.

ger had allowed the people to paint his forehead red with vermillion.

The following account records three instances where since 1975 mugger crocodiles have lived in peaceful coexistence in village ponds after entering these during floods from the River Mahanadi, and another instance where the mugger took refuge in cow-sheds during the flood.

CASE HISTORIES

Case I.

On 13 October 1977 I confirmed the presence of a mugger, about 1.5 m long, in a tank near village Beherasahi on the eastern bank of the Satkoshia Gorge of River Mahanadi, about 19 km upstream from the foot of the gorge.

During the dry season the tank is about 130 m in length and 22 m in width with maximum water depth of about 1.5 m. In the rainy season the size of the tank is almost doubled and the depth increases to 2.5 m. The tank is separated from the river by a 16 m wide river bank plus a low lying valley, about 100 m wide, and then the bank of the tank, a further 10 m wide. During the flood, water flows from the river through the valley and the tank. Following the flood, however, the valley becomes dry although a slow stream may still be connecting the tank with the river at the lower end even until May.

Following complaints from the villagers to remove the mugger from the tank as the tank was used by cattle and the mugger was "eating away" all the fish in the tank, several unsuccessful attempts were made to catch the mugger. The tank was also used by the villagers to take bath during the monsoon and the immediate post-monsoon periods. They noticed that the mugger remained away from the bathing ghat, did't do any harm to goats and other small cattle, and was rather shy, always entering the water when people came to the bathing ghat. Thus the mugger was allowed to remain in the tank. Later it became fun for the cowherds to watch it from a distance and report to us when we went there. In the beginning people were afraid of entering the tank to fish, but later they did not mind the presence of the mugger and freely netted. Everytime, of course, they expected to catch the mugger too and present it to us to return to the river. In the first week of May 1978 the mugger left the tank, probably during the night, to be later seen in the river.

During its seven months stay in the tank the mugger was never a threat to any of the animals using the tank, or bathing children. On one occasion the mugger permitted me to approach slowly to within two metres to take a photograph. Once it was reported that the mugger had attempted to attack a small monkey when the latter had lowered its head to drink.

Case II.

During the same year another juvenile mugger, also of about 1.5 m in length, had entered a swamp in village Chhamundia, about 15 km downstream from the foot of the Satkoshia Gorge, along the western bank. This swamp is by the side of a stream connecting the river to the catchment area of a range of distant hills. During dry season the swamp is about 50 m from the stream and 100 m from the river. Then it is about 200 m in length and 150 m in width holding water of about 2 m deep. The swamp is greatly disturbed by cattle and man, there being much fishing activity. During rains the swamp is connected to a small village pond, 60 x 50 x 2 m, situated about 200 m away on the far side of a motorable road.

The mugger often used to walk out of the swamp and go to the pond, return back the next morning or after a few days. People had on some occasions seen the mugger on the road. Either in the swamp or in the pond the mugger remained in the area for a total of about twentyone months, from 1977-rains to May 1979. After that the mugger returned to the river. Although there was the usual complaint that the mugger was "eating away" all the fish from the swamp and the pond, the mugger was never a threat to the children and cattle using the two places.

Case III.

Similar to the above two instances, a 2 m mugger from the river used to come to a pond in village Titigaon, along the western bank of the river, about 37 km upstream from the foot of the Gorge, during the flood in the years 1975 to 1978. People used to see it in the pond after the floods for the next three to four months, but never knew exactly when the mugger returned back to the river. The tank is used by the villagers and their cattle. In none of the years had the mugger attacked any man or animal.

Case IV.

During high floods mugger have been reported to have taken refuge in cow-sheds in Boudh area beside the River Mahanadi. People believe that the crocodiles were trying to escape the current in the river, and others felt that the mugger had come to attack the cattle, although no actual attacks were reported. In every case, however, the mugger used to be beaten to death. Such conduct of stealthily entering into cow-sheds has earned for the mugger a local name, *'Chora Kumbhira'* (Oriya, = 'thief crocodile').

DISCUSSION

In all the cases mentioned above, the crocodiles left the main river during high floods. A reason for this behaviour is to avoid the strong currents in the river, and secondly, where they enter village ponds, they follow the movement of fish. Gharial are known to enter into the side streams during the flood (Bustard and Singh, in press) in accordance with the movement of their prey fish. Mugger entering into cow-sheds is something perplexing and inexplicable. However, it could be that, taking advantage of their capability to perform long-distance terrestrial movements, the mugger prefers warmth during the cool rainy weather.

The reason for the return of the mugger, which had entered the ponds during the flood, into the river may be due to cumulative or singular factors like low water, shortage of food and disturbance by people and cattle. However, everywhere they lived peacefully with people and their cattle.

Cott (1961) wrote of the Nile Crocodile (*Crocodylus niloticus*) that during the rains crocodiles often follow fish or to find warm water.... Eventually as the pool dries up, they attempt to regain the valley and are sometimes found moving over land far from water. Parallel observations have also been made of the gharial (*Gavialis gangeticus*), where released juveniles have entered village ponds along with flood water (Unpubl. info.).

The above discussion brings us at a situation in crocodile management which is particularly significant for the current 'grow and release' practice adopted as a conservation-rehabilitation measure for the Indian crocodilians. Young crocodiles after release into a main river should be expected to move into adjacent ponds or streams during the flood (pers. obs.)

for the gharial, and S. Kar (pers. comm.) for the saltwater crocodile, *Crocodylus porosus*), and the 'manager' should be in a position to trace these and bring confidence to the people by demonstrating that he is there to tackle the problem if a crocodile proves a nuisance.

Adult mugger and saltwater crocodiles over 2.5 m may attack or attempt to attack a goat or dog on the bank. During 1978-flood a 10-12 ft. (3.0-3.6 m) mugger had pulled into water a small goat grazing on the banks of River Chitrotpala near Bhagawanpur village, Orissa.

However, it is at the same time important to note that in the Satkoshia Gorge of the River Mahanadi, where mugger formerly occurred in hundreds and a few still survive to this date, no attack on any human life or cattle have been reported at least during the last twentyfive to thirty years. Furthermore, the people of village Kujanga and other nearby villages besides the bank of lower Mahanadi were well accustomed to the habits and behaviour of all three species of Indian crocodilians, namely, the gharial, the mugger and the saltwater crocodile. While they are specifically afraid of the saltwater crocodile's unpredictability, they do not fear the mugger and say it is a shy crocodile, scared of man and thus not a threat to people or cattle.

ACKNOWLEDGEMENTS

I wish to record my gratitude to the Orissa Forest Department staff at the Gharial Research and Conservation Unit, people beside the river Mahanadi, Sri B. C. Choudhury, Sri S. Kar and my friends from Kujanga Sri Pramod Mahapatra and Sri Kshirod Mishra for help and information. Dr. H. R. Bustard read through the manuscript.

L.A.K. SINGH[1]

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June 11, 1982.

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11. ON SITANA LIZARD IN KALAKAD SANCTUARY

In Kannupulisaragam of Valliyur section of Kalakad Sanctuary on the road and boundary between the Kanyakumari and Tirunelveli Districts, the Sitana lizard or Fanthroated lizard *Sitana ponticeriana* is very common. The area is generally rocky all over with thorny bushes of *Acacia planifrons, Euphorbia randia* etc. Only about 30% of the ground is covered with vegetation. Here there is a large concentration of the lizards. In May 1980 I did a count of the lizards on 2 days in an area of 1000 m x 100 m using pocket compass and tape and dividing the area in 100 m^2. There were in all 82 lizards 35 pairs and 12 individuals. Each pair moved within small area of about 30 m^2. When chased out of this area they returned back. The bluish red dewlap was exhibited by the male from small rocks. They were not seen on rocks higher than about 1m. Dr. Rajendran says that they climb trees and bushes though I have not seen any climbing trees. This lizard is not common in other parts of the Sanctuary. I have not seen it in Mundanthurai Sanctuary.

J. MANGALRAJ JOHNSON

WILDLIFE WARDEN,
MUDUMALAI WILDLIFE SANCTURY,
TEMPLETON COTTAGE, VANNAPET,
UDHAGAMANDALAM 643 001,
TAMIL NADU,
November 12, 1982.

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12. ON A NEW RECORD OF THE GENUS *GNATHOLEPIS* BLEEKER (GOBIIDAE, TELEOSTEI) FROM SOUTH-WEST COAST OF INDIA

(*With three text-figures*)

INTRODCTION

Neither Day (1889) nor Koumans (1941) recorded any member of the genus *Gnatholepis* from Indian waters. Herre (1927) in his account of the gobies of the Philippines and the China sea described 7 species of the genus of which 5 were later synonymised with *Acentrogobius* spp. by Koumans (1953). Koumans (op. cit.) described three species of the genus from the Indo-Australian Archipelago namely *G. balliurus* (C. & V.), *G. calliurus* (J. & S.) and *G. anjerensis* (Blkr.). All the above species were recorded east of Singapore. However Smith (1959) recorded *G. balliurus* (C. & V.) from the Western Indian ocean. In an extensive collection to study the taxonomy of gobiid fishes from the South-west coast of India an apparently strange specimen was collected which on detailed studies, in its characters with *G. calliurus*, a species not so far recorded from Indian waters.

METHODS

Measurements to the nearest millimetre, were made following the criteria of Hubbs & Lagler (1964). The body measurements were then converted into percentages of standard length while those of head region into percentages of head length. The meristic data were collected following Koumans (1953). The last ray of second dorsal and anal, though double, was counted as one. The cephalic sensory canals and open pores were studied blowing air or injecting water-soluble ink into them. The terminology for the sensory canals and pores are those of Akihito & Meguro (1975) and Macdonald (1972) respectively. The pit organs (sensory papillae) were examined under low power binocular microscope after light staining with alizarin

Fig. 1

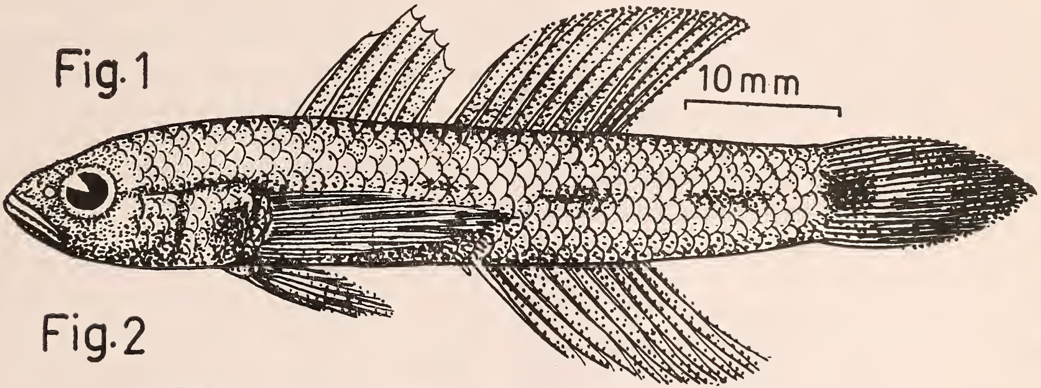

Fig. 2

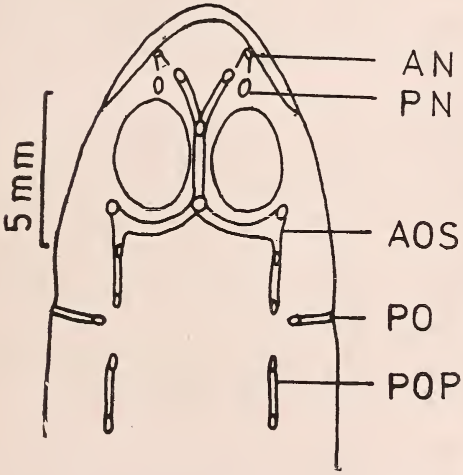

Fig. 3

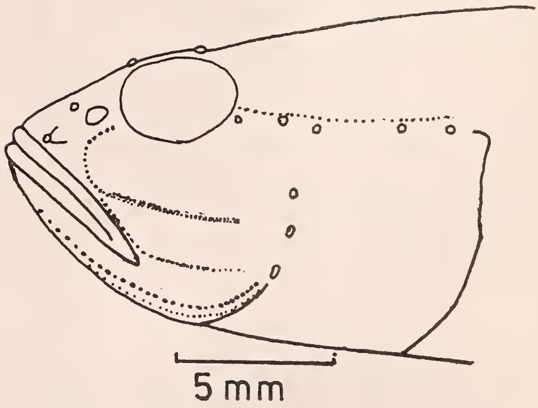

Fig. 1. *Gnatholepis calliurus* (Jordan & Seale) (Male)
Fig. 2. Dorsal view of the head of *G. calliurus* showing the pattern of arrangement of the sensory canals and open pores.
Abbreviations
AN, Anterior nostril; AOS, Anterior oculoscapular canal; PN, posterior nostril; PO, Preopercular canal; POP, posterior oculoscapular canal.
Fig. 3. Lateral view of the head of *G. calliurus* showing the sensory pores and pit organs.

red. The description of the pit organs is mainly restricted to illustrations.

Gnatholepis calliurus Jordan & Seale (Fig. 1)

Gnatholepis calliurus Jordan & Seale, 1905, p. 796; Chabanaud, 1923, p. 559; Herre, 1927, p. 130; Koumans, 1941, p. 123; 1953, p. 171.

Material: Single specimen (M) of 5.40 cm, Standard length (SL) (6.80 cm Total length).

1) *General description*:

Body elongate and compressed. Dorsal and ventral profiles convex. Depth of body 16.67%, caudal peduncle length 25.93% and depth 12.96% of SL. Body length from snout tip to first dorsal 37.04%, to second dorsal, 51.85%, to pelvic base, 31.48% and to anal opening, 55.56% of SL.

Head compressed, dorsal profile convex, length 31.48%, width 16.67% and depth, 18.52% of SL. Snout obtuse, length, 23.53% and height at the anterior margin of the orbit, 32.35% of head length. Eyes dorso-lateral, diameter, 23.53% and interorbital, 5.88% of head length, the latter about 1/4 the former. Head without tentacles or spines. Anterior pair of nostrils mounted on very short tubes.

Mouth oblique, lower jaw prominent, lips thin, cheeks not conspicuously inflated. Maxillary extends to below the anterior margin of eye. Gill opening continued anteriorly; isthmus narrow.

2) *Teeth*:

Teeth in several rows on both jaws. Outer row of teeth on both jaws enlarged and inner rows smaller. Outer row of teeth on upper jaw widely spaced, about 18 on each side, many caninoid. Innermost row also slightly enlarged. On lower jaw outer row of about 13 teeth on each side does not extend the whole length of the jaw laterally, but stops short by a small distance. The last pair of teeth, not canines. The inner rows extend the whole length of the jaw. Tongue truncate.

3) *Fins*:

First dorsal longer than body, made of 6 flexible spines. Middle rays longer, second the longest, 19.44% of SL. Length of fin at base 13.89% SL. Interspace between dorsals very small, 2.78% of SL., with two median scales. Second dorsal and anal similar, both posteriorly pointed, posterior rays longer and as high as body. Second dorsal composed of one spine and 10 branched rays. Length of the fin at base 22.22% and the longest ray, 18.52% of SL. Anal with one spine and 9 branched rays. Length of anal at base 19.44% and the longest ray, 18.52% of SL. Pelvic single, obtuse, 24.07% of SL, with one spine and 5 branched rays on each side. Pectoral obtusely pointed, 31.48% of SL composed of 17 rays. Caudal obtusely rounded, 25.93% of SL, formed of 17 segmented rays.

4) *Scales*:

Head with large cycloid scales dorsally, behind the eyes, on opercle (3 rows), cheek and pectoral base. Scales on anterior part of body, breast and belly cycloid, thin and shed easily and the rest ctenoid. Scales on body large and arranged in definite rows.

L.1. 25; Ltr. 8; Pr. S (Predorsal scales). 10; Po. S (Postdorsal median scales).

5) *Branchiostegals*:5

6) *Cephalic-lateralis system*: (Figs. 2 and 3)

All the three usual canals are present. The anterior oculo-scapular canals on either side join together in the inter-orbital region and the single median canal opens anteriorly and posteriorly by the respective inter-orbital pores. From the anterior inter-orbital pore the canals separate and run anteriorly, one on either side to open by the single nasal pore situated slightly mesially in between the two nostrils. There is no post-orbital pore and the canal from the posterior inter-orbital pore opens laterally to the post-infraorbital pore, which in turn continues posteriorly and opens by the two lateral pores on each side. The posterior oculo-scapular canal, which is short, has the anterior and posterior pores and the pre-opercular canal has the dorsal, middle and ventral pores as is typical in gobiid fishes.

The pit organs are not distinct as the cheek and opercle are scaled. In between the rows of scales a few longitudinal lines are however evident over the cheek and there are no transverse lines.

7) *Colour Pattern*: (Freshly preserved specimens)

Body greyish yellow with uniformly distributed spots and greyish markings on the dorsal part and yellowish white ventrally. Interorbital and snout dark. A roughly triangular, black blotch over opercle. A black mark on the caudal base, anterior to which, and on the midlateral line, there are one or two indistinct black patches.

Dorsal and anal greyish yellow, with irregular small black spots all over. Pelvic yellowish, with dark spots in the central region. Pectoral slightly greyish yellow, with irregular grey spots. Caudal darker without bands.

8) *Habitat*:

Specimens studied were collected from the estuary at Neendakara near Quilon on the Kerala coast.

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9) *Distribution*:

According to Koumans (1953), the fish is known from Singapore, Indonesia and East Indian Archipelago.

Remarks

The genus *Gnatholepis* Bleeker is recorded for the first time from Indian waters. The characters of the present specimen of *G. calliurus* agree closely with those given by Herre (1927) and Koumans (1953). The more important differences are the following.

	Herre (1927)	Koumans (1953)	Specimen described
Height of the body in SL	4.50—4.83	4.50—5.00	6.00
Eye in head length	3.50—4.00	3.50—4.00	4.30
Interorbital in eye	5.00	—	4.00
Maxillary	extends to below the anterior part of eye	extends to below the middle of eye	extends to below the anterior margin of eye
Tongue	rounded	rounded	truncate
L.1.	28—30	28—30	25
L. tr.	10	10	8

The senior author (C.G.) is thankful to the from that given by the above authors.

Acknowledgement

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13. A NEW RECORD OF *EPINEPHELUS GUAZA* (LINNAEUS, 1758) (SERRANIDAE: PISCES) FROM INDIAN WATERS

INTRODUCTION

While carrying out a survey on the biota represented in the rockpools off Visakhapatnam coast, an interesting species of serranid fish belonging to the genus *Epinephelus* was collected. *E. quaza* was described earlier by Smith (1961) and Smith, C. L. (1971) from South Africa and America. The species is being recorded for the first time from Indian waters and hence a short description is given.

MATERIAL AND METHODS

Collection of fishes was done using a hand net of 0.6 m diameter. In taking the morphometric data, a measuring board, a dial as well as a Vernier Callipers were used and the methodology of Hubbs & Lagler (1958) was followed.

The data is based on a female specimen measuring 200 mm in standard length, collected on 6-2-1980.

DESCRIPTION

Counts: D XI, 16; A III, 8; p. 18; V I, 5; C 13; gillrakers 8+1+15; lateral line scales 60; 1. tr. 14/1/29.

As percentage of standard length: total length 125.00; body depth 75.00; head length 42.00; snout 9.00; eye diameter 6.00; inter-orbital 4.50; pectoral length 23.50; ventral length 18.00; caudal peduncle length 12.00; distance to dorsal 33.0, to anal 75.0, to pectoral 35.0, to ventral 39.0.

As percentage of head length: snout 21.43; eye diameter 14.29; inter-orbital 10.71.

Body oblong, slightly compressed, deepest under the origin of dorsal. Cycloid scales on anterior half of body and upper and lower parts of flanks, rest of the body with ctenoid scales; mouth oblique, gape large, lower jaw slightly projecting; maxilla large reaching below the hind margin of eye; nostrils round, posterior one larger. Eyes large. Teeth pointed and small, in 3-4 rows on upper jaw, outermost row of teeth slightly bigger, one tooth on either side of symphysis enlarged, two rows of teeth on lower jaw, two on each side of symphysis enlarged; arrow-head shaped patch of teeth on vomer, 3-4 rows of teeth on palatines, patches of teeth on roof and floor of pharynx. Vertical edge of pre-opercle serrated with a broad shallow concavity just above the rounded and serrated angle, horizontal edge smooth. Three spines on opercle, middle one being larger. Fourth dorsal spine longest, longest ray longer than longest spine, rays reach caudal base when folded back. Third anal spine longest and stoutest, longest ray longer than longest spine; rays reach latter half of caudal peduncle. Pectorals rounded and do not reach vent, ventrals do not reach vent. Caudal rounded.

Colour: Chocolate brown body with large and irregular pale blotches all over the body. Ventral side up to anal pale yellow. Edges of all fins black. Pectoral base brown, orange in the middle with black edge.

REMARKS

This grouper was collected from a crevice adjoining a rockpool at low tide. The above description conforms to that of *Epinephelus quaza* by Smith (1961) and also by Smith, C. L. (1971). The recorded maximum length of this species is 900 mm (Barnard 1927). The collection of a lone specimen over a collection period of three years indicates the rarity of this species.

ACKNOWLEDGEMENTS

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14. ON THE EXTENSION OF RANGE OF A FRESHWATER CATFISH — *GLYPTOTHORAX LINEATUS* (DAY) (SILURIFORMES; SISORIDAE) — TO POONCH VALLEY (JAMMU AND KASHMIR STATE)

Sisorid catfishes of the genus *Glyptothorax* Blyth are typical torrential-stream teleosts which prefer fast-flowing mountain streams and possess a thoracic adhesive apparatus composed of longitudinal plaits of skin by which they can hold on to stones, roots and other firm objects. The rays of the paired fins also bear adhesive skin on their under surface. The range of distribution of *Glyptothorax* Blyth is Syria, Pakistan, India, Nepal, Burma, Malaya, Thailand, Laos, Sumatra, Java, Borneo and China (Hora 1923).

Glyptothorax lineatus (Day) is a freshwater sisorid of India which has been previously recorded from the Yamuna, the rivers of the Terai region and Duars of northern Bengal. Outside India it also abounds in the Kosi River in Nepal and the Sankha River in Burma (Misra 1976). There is, thus, no previous record of the occurrence of this sisorid in northern India upto date and the present report of this species is a new record for Jammu and Kashmir State.

Specimens of *G. lineatus* (Day) were collected from Poonch River and Betarh Nallah of Poonch Valley by me during 1979-1980, where it common in the rock-pools as well as the rocky-streams flanking the course of the main river. The thoracic adhesive apparatus being well-developed with a central pit-like depression, the fish manages to stay stuck to the submerged stones and boulders and thus escapes being washed away by the turbulent waters of the river.

Following species of sisorid cat-fishes belonging to the genus *Glyptothorax* Blyth have been reported from Jammu and Kashmir State upto date :

Species	Locality	Authors
1. *Glyptothorax kashmirensis* Hora	Kashmir Valley	Hora (1923); Silas (1960); Das (1965).
	Poonch Valley	Das & Nath (1971)
2. *G. pectinopterus* (McCl.)	Poonch Valley	Das & Nath (1971)
	Bhaderwah (Jammu)	Malhotra *et al.* (1975)
3. *G. botium* (Ham.)	Salahar area (Jammu)	Malhotra *et al.* (1975)
4. *G. conirostre* (Steind.)	Poonch and Sooran valleys	Nath (1981)
5. *G. lineatus* (Day)	Poonch Valley	New Record

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I am grateful to the Director, Zoological Survey of India, Calcutta, for confirming the identification of the specimens under report. Thanks are also due to Dr. K. C. Jayaram, Dy. Director, Zoological Survey of India, Calcutta, for his valuable opinion.

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15. FIRST RECORD OF *ODONTOTERMES BELLAHUNISENSIS* HOLMG. & HOLMG. FEEDING ON *COCOS NUCIFERA* LINN.

The coconut palm, *Cocos nucifera* is a tropical plantation crop seen particularly in coastal areas. It is liable to be attacked by more than thirty species of termites in various parts of the world. In India, only two species of the genus *Odontotermes* have been reported as pests of coconut palm. The damage caused by *O. obesus* on young plants and mature palms is considerable, particularly on the west coast (Nirula *et al.* 1953). *O. malabaricus* has been recorded as pest of coconut palm in Tamil Nadu (cf. Roonwal 1979). In other countries such as Sri Lanka, *O. redemanni* and *O. horni*, and Somalia, *O. classicus* have been recorded as culprit species of coconut palm (Harris 1971). However, no information is available on any other species of *Odontotermes* as pest of coconut palm. During a survey of termite damages to coconut palms of some parts of the east coast, particularly Ganjam district (Orissa), *O. obesus* was recorded as a serious pest attacking both saplings and mature palms. Besides, *O. bellahunisensis* was also recorded feeding on both young and mature coconut palms in plantations between Gopalpur-on-sea and Chatrapur, Ganjam (Orissa). Interestingly, it is not only the first record of *O. bellahunisensis* feeding on coconut palm, but also its first recorded appearance in the eastern zone including Bangladesh (Sen-Sarma 1974). However, it has been reported as a polyphagous feeder damaging a number of plants (Sen-Sarma *et al.* 1975).

O. bellahunisensis was recorded in coconut plantations on laterite soils, infesting the roots and lower portions of the trunk adjacent to the soil surface. Its mud-sheet covering over the trunk, was measured to an height of about 12 to 15 cm. It was recorded feeding on the outer most dried tissue of the trunk. In addition, it was recorded infesting the fallen petioles, rachises (mid-ribs) and leaflets of the leaves, and spathes of the palm. It was estimated that the attack on coconut palm by *O. bellahunisensis* was only about ten per cent which was comparatively less than that of *O. obesus.*

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16. NOTES ON HOST-PLANTS, FEEDING BEHAVIOUR, INFESTATION AND ANT ATTENDANCES OF COTTON APHIDS *APHIS GOSSYPII* GLOV.

Behura (1963, 1965) reported the occurrence of A. *gossypii* in India on as many as 142-plants belonging to different families. Since then 20 more have been added to the list (Behura and Roy 1980).

The principal crops which are usually attacked by these cosmopolitan polyphagous aphid species are cotton, brinjal, chilli, melon and bhendi. Eastop (1961) reported as many as 60 host-plants of *A. gossypii* in Africa. According to our survey the total number of host-plants throughout the world comes to not less than 220 belonging to 46 families. The distribution of aphid on plant species in all the families are enlisted in Table 1. Families with the largest number of plants infested by the aphids are in the following order:- Solanaceae (30 species), Asteraceae (22 species), Cucurbitaceae (19 species), Malvaceae (17 species) and Fabaceae (10 species).

TABLE 1

NUMBER OF PLANT SPECIES OF DIFFERENT FAMILIES INFESTED BY *Aphis gossypii* GLOVER

Sl. Nos.	Name of the families	Number of species of plants infested by *A. gosspyii*
1.	Araliaceae	1
2.	Apocynaceae	2
3.	Violaceae	1
4.	Fabaceae	10
5.	Vitaceae	1
6.	Verbenaceae	9
7.	Asteraceae	22
8.	Solanaceae	30
9.	Araceae	3
10.	Cucurbitaceae	19
11.	Acanthaceae	3
12.	Chenopodiaceae	1
13.	Dipterocarpaceae	1
14.	Rosaceae	4
15.	Euphorbiaceae	5
16.	Annonaceae	1
17.	Apiaceae	2
18.	Myrtaceae	2
19.	Oxalidaceae	1
20.	Lamiaceae	5
21.	Malvaceae	17
22.	Lythraceae	3
23.	Rubiaceae	3
24.	Balsammaceae	1
25.	Convolvulaceae	2
26.	Ulmaceae	1
27.	Capparidaceae	3
28.	Iridiaceae	1
29.	Moraceae	5
30.	Commelinaceae	2
31.	Tiliaceae	2
32.	Boraginaceae	1
33.	Amaranthaceae	2
34.	Bersaraceae	1
35.	Cannabinaceae	1
36.	Nyctaginaceae	2
37.	Polygonaceae	2
38.	Cannaceae	1
39.	Punicaceae	1
40.	Urticaceae	1
41.	Brassicaceae	1
42.	Bignoniaceae	1
43.	Rutaceae	6
44.	Caesalpiniaceae	2
45.	Zingiberaceae	1
46.	Asclepiadaceae	2

Feeding in the aphid species has been observed althrough day and night on brinjal plants (*Solanum melongena*). They anchor themselves by inserting the beak (rostrum) into the plant tissue and occur on different parts of the plant although the greatest concentration is noticed on the foliage. At the time of feeding plant sap a sort of rhythmic jerk is exhibited by them. Mostly feeding is observed on the undersurface of leaf indicating thereby their avoidance of direct sunlight.

All aerial parts of the brinjal or egg plant are prone to the attack of *A. gossypii.* The upper side of the leaf is more hairy and remains exposed to sunlight while the lower side is less hairy and dark. Aphids invariably are marked on lower surface. In case of acute infestation the aphids are found on the petioles, flowers, buds or base of fruit. In severe infestation a single leaf (average surface area of 187 sq. cm.) was observed to hold as many as 400 aphids (including adult and immature ones). Infestation on very young brinjal plant is noticed when the plant has 2-3 leaves on its axis. The aphids are noticed in very negligible numbers on old or senescing leaves. At Bhubaneswar (Orissa) these aphid species are found almost throughout the year, heaviest infestation occurring during either September-November or March-April depending on early or late sown crops. Aphids usually prefer the plant at their flowering and fruiting stages.

A. gossypii is a myrmecophilous type of aphid species attended by ant species i.e. *Camponotus* (*Tanaemyrmex*) *compressus* Fabr. reported by Behura, 1965. But later on 3 more have been added to the list all belonging to subfamily Myrmecinae (Roy and Behura 1980).

They are (1) *Bothriomyrmex dalyi* Fabr. (2) *Meranoplus bicolor* Guer. (3) *Solenopsis geminata* Fabr.

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17. FIRST RECORD OF *MESOCOMYS* CAM. (HYM.: CHALCIDOIDEA, EUPELMIDAE) IN INDIA[1]

(*With ten text-figures*)

Genus *Mesocomys* Cam.

Mesocomys Cameron, 1905, Proc. S. Afr. Philos. Soc., XV, P. 210

Type species, *Mesocomys pulchriceps* Cameron.

The genus *Mesocomys* Cam. is a poorly known member of the family Eupelmidae, closely related to *Anastatus* Motsch. from which it can be very easily separated by the characteristic antennae (Fig. 4) (Antennae with transverse or subquadrate funicle segments, pedicel very long, as long as preceding four funicle segments combined, including annelus); scutellum in the female with two grooves at the base, forewings (Fig. 5) in the female entirely infuscated except the base hyaline and two hyaline spots, one close to the marginal vein and second opposite near the hind margin of wing. The wings of male are completely hyaline.

Mesocomys orientalis Ferr. (Figs. 1-10)

Mesocomys orientalis Ferriere 1935. *Stylops* 4: 145-153.

Material examined: INDIA: U.P., Pantnagar, 10.5.1981, 200 ♀♀, 80 ♂♂, reared from eggs of *Trabala vishnov* Lefebvre, Castor hairy caterpillar (Lepidoptera: Lasiocampidae) on castor plant (M. A. Khan). Material will be deposited in Z.S.I., Calcutta, India.

A detailed description of the species was given by Ferriere (1935). The following characters may be added to the species based on above material.

Female 2.3-2.6 mm. Body dark brown with cuperous reflections on frons, vertex and thorax; malar space shining bluish green, face yellowish; mandibles yellowish with apical margin brownish; abdomen dark brown with shining bluish green reflections on dorsum; antennal scape yellow with a brown spot at base below, rest of the antennae light brown with yellowish reflections.

Mandible bidentate (Fig. 1) with two blunt teeth, maxillary (Fig. 2) and labial palp (Fig. 3) 4 and 3 segmented respectively, apical segment of maxillary palp gradually expanding, distinctly longer than preceding two segments combined; pedicel (Fig. 4) two and a half times as long as wide, club with blunt apex, distinctly much shorter than preceding five funicle segments combined; propodael spiracle almost touching the anterior margin of propodaeum; forewings (Fig. 5) extended much beyond the tip of abdomen, three times longer than wide, marginal vein distinctly longer than postmarginal vein, stigmal vein distinctly shorter than postmarginal; hind wings almost three and a half times longer than wide, apex of marginal vein with three curved hooklets; mid tibial spur (Fig. 6) distinctly shorter than basitarsus, apex of tibiae and tarsal segments 1-4

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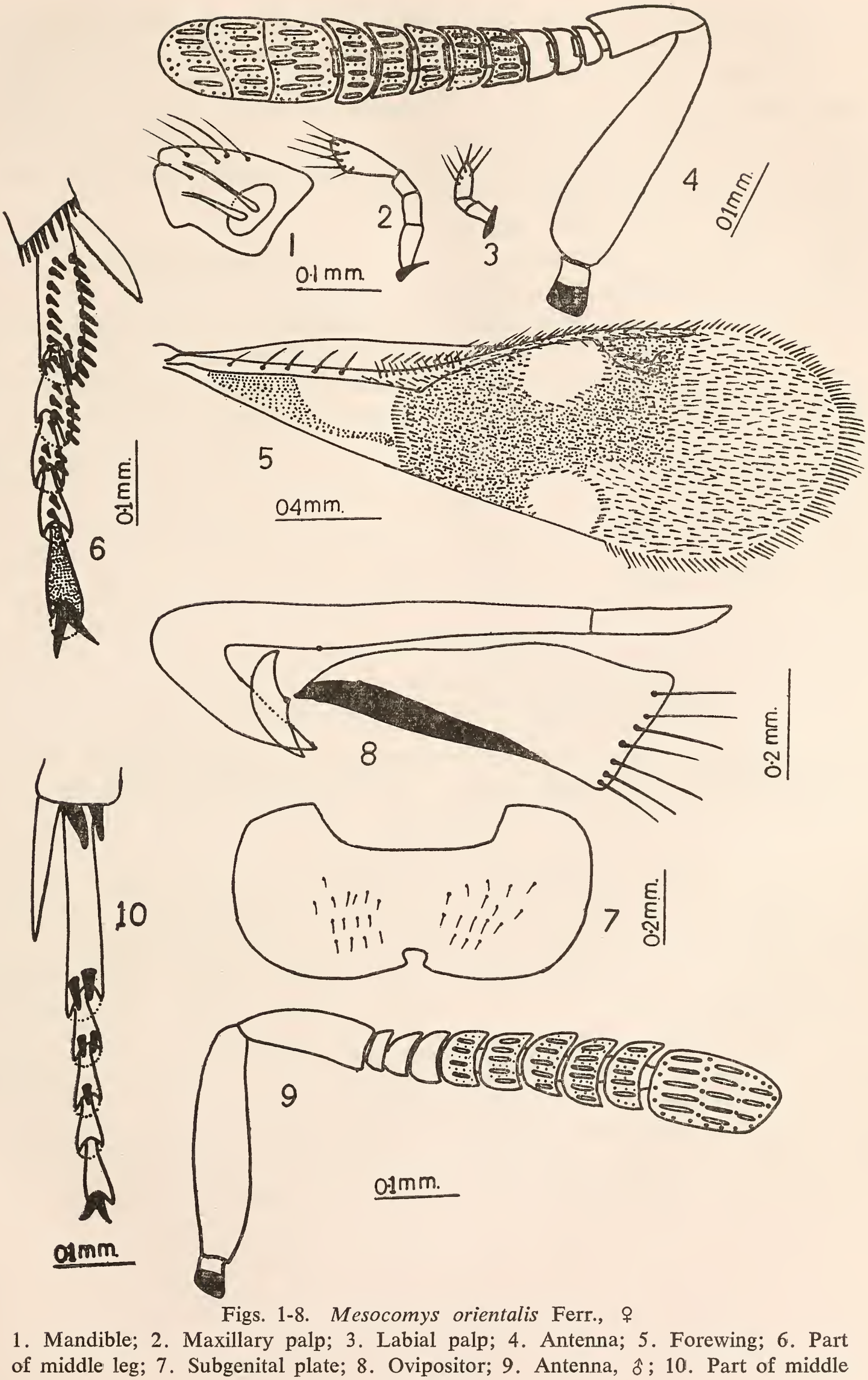
[1] Research paper No. 2625 through the Experiment Station, G. B.P.U.A. & T., Pantnagar, Nainital, U.P., India.


4
0·1mm.
1
2
3
0·1 mm.
6
0·1mm.
5
0·4mm.
8
0·2 mm.
10
7
0·2mm.
9
0·1mm.
0·1mm.

Figs. 1-8. *Mesocomys orientalis* Ferr., ♀
1. Mandible; 2. Maxillary palp; 3. Labial palp; 4. Antenna; 5. Forewing; 6. Part of middle leg; 7. Subgenital plate; 8. Ovipositor; 9. Antenna, ♂; 10. Part of middle leg, ♂.

with 10, 25, 8, 4 & 2 pegs respectively; subgenital plate (Fig. 7) extending a little beyond the middle of abdomen, posterior margin of subgenital plate rounded with an inverted U shaped notch in the middle, anterior margin deeply concave in the middle; first valvifer (Fig. 8) semicircular with articular knobs prominent, second valvifer long (Fig. 8), third valvulae (Fig. 8) lanceolate, outer plates of ovipositor (Fig. 8) narrow at base gradually expanding at apex with a ridge along outer margin.

Male: 1.9-2.2 mm. antennae yellow with some infuscation on flagellum, pedicel (Fig. 9) almost three times as long as wide, club unsegmented, shorter than preceding three funicle segments; apex of tibiae (Fig. 10) and tarsal segments 1-3 with 2, 2, 2 and 1 peg respectively.

Distribution: South and Central Africa, Asia, Burma, Rangoon; India, U.P., Pantnagar (New record).

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REFERENCE

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18. *NESIDIOCORIS CAESAR* (BALLARD) (HETEROPTERA — MIRIDAE): A NEW PEST OF BOTTLE GOURD AND TOBACCO PLANTS

Nesidiocoris caesar (Ballard) is a sap sucking bug first reported by E. Ballard (1927) from Godavari District in South India on tobacco. It was described as a new species named *Cyrtopeltis* (*Gallobelicus*) *caesar*.

During the survey of the fields growing bottle gourd in Western U.P., from 1977-1981, it was found that the entire crop was infested by this bug and consequently leaves had became yellow, mottled and fruit setting was minimum and the crop was abandoned. No information was then available on the species but later it was identified by the Commonwealth Institute of Entomology, London.

The species infests Virginia variety of tobacco plants during winter, though the damaged mottled leaves remain commercially viable as they are utilized for processing as tobacco.

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REFERENCE

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19. A NOCTUID DEFOLIATOR PEST, *DICHROMIA OROSIA* CRAMER (NOCTUIDAE: LEPIDOPTERA) OF ANTAMUL, A MEDICINAL PLANT

Antamul, *Tylophora asthmatica* (Asclepiadaceae) a medicinal plant whose leaves and roots are used as emetic, expectorant, diaphoretic, alterative, blood purifier and stimulant and is the best indigenous substitute for ipecacuanha (Dastur 1977). The leaves and roots contain the alkalid tylophorine which is similar in action to ipecacuanha.

During the second week of December, 1981 Antamul, grown at the Regional Research Station, University of Agricultural Sciences, Dharwad Campus, Karnataka was found heavily infested by this pest. The caterpillars damaged the leaves eating them from the margin.

The females laid eggs singly on the undersurface of the leaves. The eggs were smooth, green in colour and dorsoventrally flat. On hatching, the grubs restricted themselves to the undersurface of the leaf and defoliated. The larvae orange, the head and somites provided with series of small black tubercles. The full grown grub pupated in silken cocoons in soil below the plant or in leaf folds.

The head and thorax of newly emerged adult moths were clothed with grey black mottled scales, abdomen orange, forewing grey. A large sub-triangular black patch with pale edges occupying the medial area but not reaching the inner margin hind wings orange, the apical area black, undersurface of the forewing fuscous. This is the first record of the pest on the medicinal plant.

Department of Entomology,
College of Agriculture,
Dharwad-580 005,
May, 31, 1982.

M. C. DEVAIAH
R. RAJSHEKHAR GOUDA
Y. K. KOTIKAL
SUHAS YELSHETTY

REFERENCE

Dastur, J. F. (1977): Medicinal plants of India and Pakistan. D. B. Taraporevala Sons and Co. p. 212.

20. OCCURRENCE OF *KURZIA LATISSIMA* (KURZ), 1874 (CRUSTACEA: CLADOCERA: CHYDORIDAE) IN INDIA

(*With three text-figures*)

During the course of Survey of Cladocera from Madhya Pradesh, I collected one female specimen of *Kurzia latissima* (Kurz) from Bharma tank, Jabalpur district, Madhya Pradesh on 27 September 1982, which constitutes a new record from Indian fresh waters. The presence of this species in India is rather surprising as it is a Holarctic and Neotropical species, recorded only from European U.S.S.R. to the mouth of Syrdar'ya River in the East and from United States. Thus the present finding extends its known distribution to Madhya Pradesh, India.

Kurzia latissima (Kurz), 1875

Family: Chydoridae, Subfamily: Aloninae

Genus: *Kurzia* Dybowski & Grochowski, 1894.

Hellich, 1874: 219 (*Alona tenuirostris*); Kurz, 1875: 46-47, Plate II, Figures 13, 14, 15, (*Alonopsis*); Hudendroff, 1876: 5-56, Plate II, Figures 7a, 7b (*Alona angusticandata*); Birge, 1879: 32, Plate I, Figures 14, 15 (*Alonopsis media*); Lilljeborg, 1900: 442-445, Plate LXVI, Figures 1-7; Sars, 1901: 85-87, Plate XII, Figures 2, 29, 2b (*Pseudolona*); Frey, 1959: 35, Figures 12, 13, 14; 1962a: Figures 12, 13, 14; Herbst, 1962: 84, Figure 59.

FEMALE: Head and valves forming semicircular dorsal margin, Posterodorsal corner of valves rounded, situated slightly below the maximum height of the valve; posteroventral corner rounded without denticles. Dorsal keel present; head keel absent, eyes situated on the margin. Ventral margin of head S-shaped; Rostrum large, directed ventrally. Valves with lines. Antennules almost reaching apex of the rostrum. Esthetascs situated on distal of antennules. Setae on antennae 0-0-1/1-1-3. Postabdomen narrowing distally. Preanal corner not projecting but evenly round. Ocellus situated nearer to eye than to apex of rostrum. Intestine forming loops. Keel of labrum with pointed apex. Post-abdomen with 24-26 small and large marginal denticles. Length of female about 0.7 mm.

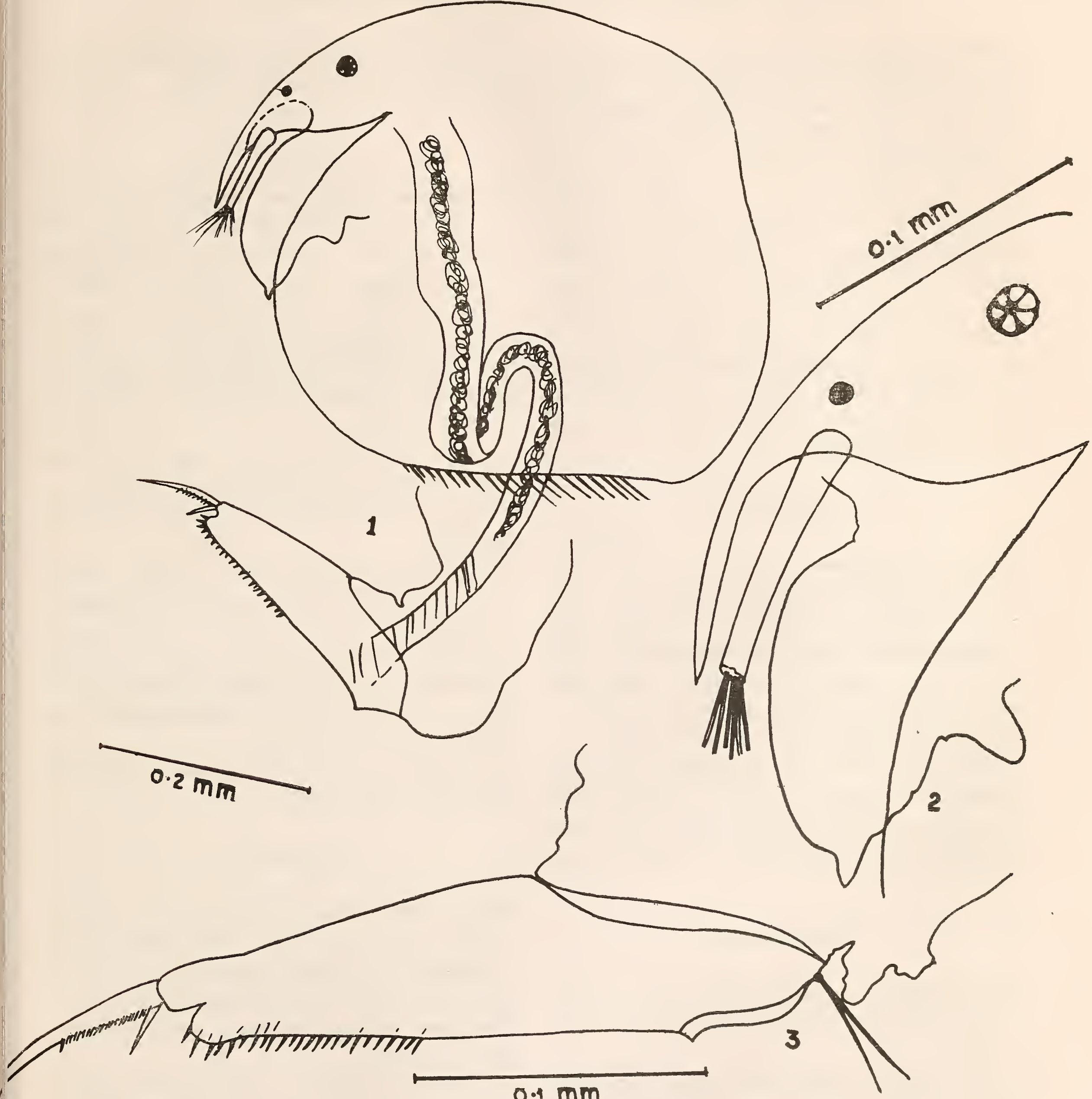
The species is very distinct in its characters and can be easily separated from the closely related *Kurzia longirostris* (Daday, 1898) by its large antennules which are almost equal to the length of rostrum, and as the preanal corner of the post abdomen does not project. The central setae on the ventral margin of the valve are rather tough and larger in size than others and the keel of the labrum has pointed apex, these characters are unique being found only in the specimens of Madhya Pradesh, and were not present in previously described specimens (Smirnov 1974).

PRAMOD RANE

ZOOLOGICAL SURVEY OF INDIA,
CENTRAL REGIONAL STATION,
JABALPUR (M.P.),
February 28, 1982.

REFERENCE

SMIRNOV, N. N. (1974): Fauna of U.S.S.R., Crustacea, Chydoridae: NTIS, U. S. Department of commerce. *Spring Field*. 487-488, fig. 476.



Figs. 1-3. *Kurzia latissima* (Kurz)
1. Parthenogenetic female; 2. Anterior side of the head showing antennule and keel of labrum; 3. Post-abdomen in lateral view.

21. ADDITIONS TO THE FLORA OF BENGAL

While making intensive plant exploration in northern parts of West Bengal *viz.* Jalpaiguri and Darjeeling Districts during March-April 1973 and October-November 1976 several interesting species were collected which on critical study proved not to have been reported earlier from West Bengal. Examination of the specimens deposited in Central National Herbarium (CAL) confirmed their earlier collections but these have not been reported so far. Hence the 5 taxa are now being reported as new records for West Bengal and additions to the Flora of Bengal. These are supplemented with relevant notes. The specimens are deposited in CAL & BSIS.

ASTERACEAE

Erigeron bonariensis Linn. Sp. Pl. 863. 1753; *Erigeron linifolius* Willd. Sp. pl. 3. 1955, 1803; Hook. f. Fl. Brit. Ind. 3: 254. 1882.

An erect hirsute herb. Stem branched. Leaves upper ones sessile, linear lower ones often stalked, broad & toothed. Heads small in corymbose panicle, white or pale purple.

Specimens examined: Rangpoo forest, Darjeeling, *B. Krishna* 404, (BSIS); Sevoke forest, Darjeeling, *D. Das* 43; 21st Mile road from Rajabhatkhawa, Jalpaiguri, *V. Narayanswami* 2315 (CAL).

GESNERIACEAE

Aeschynanthus grandiflora Spreng. Syst. 4. 238. 1827; Clarke in Hook. f. Fl. Brit. Ind. 4:338. 1885.

An epiphytic herb. Stem terete, branched, rooting at nodes. Leaves coriaceous, alternate. Flowers with red tube and orange lobes suffused with black purple dots.

Specimens examined: Chapramari forest, Jalpaiguri, *B. Krishna* 268 (BSIS).

ORCHIDACEAE

Dendrobium crepidatum Lindl. Paxt. Fl. Gard. 1: 63. t. 45. 1850-51 et nov. ed. 1:53. t. 40. 1852; Hook. f. Fl. Brit. Ind. 5: 740. 1890; Prain, Bengal Plants 2: 758. 1963 (repr.).

Epiphyte. Stem terete greenish-yellow narrow at base, thickening upwards. Leaves membranous, sheathing, oblong-lanceolate. Flowers in pairs from the nodes, white tipped with pink, lip light yellow.

Specimens examined: Kundong block, Kalijhora, Darjeeling, *B. Krishna* 380 (BSIS).

Prain (1903) recorded it from Chotanagpur in Bihar.

Phalaenopsis mannii Reichb. f. Gard. Chron. 902. 1871; 503. 1876; Hook. f. Fl. Brit. Ind. 6: 30. 1890.

Epiphyte. Pseudobulb O. Leaves oblong-lanceolate, coriaceous. Scape equalling leaves, many flowered. Flowers yellowish-brown, lip yellow with pink blotches.

Specimens examined: Kalijhora, Darjeeling, *B. Krishna* 351 (BSIS).

LILIACEAE

Smilax lanceaefolia Roxb. Fl. Ind. 3. 792. 1832; Hook. f. Fl. Brit. Ind. 6: 308. 1892.

Prickly climber, branches subterete, slender. Leaves membranous, ovate-lanceolate, opposite. Male and female flowers in umbels. Fruit a berry, tip pink.

Specimens examined: Andherijhora, Darjeeling, *B. Krishna* 325 (BSIS); Buxa-Santrawari road, Jalpaiguri, *V. Narayanswami* 2857 (CAL).

Cowan & Cowan (1929) stated in a foot note that the species was found at an altitude of 5-7,000 feet but no specimen could be located at CAL and BSIS except the above cited two specimens which were collected from places of much lower altitude.

ACKNOWLEDGEMENT

We wish to express our gratitude to the Director, Botanical Survey of India, Howrah for all the facilities.

B. KRISHNA

BOTANICAL SURVEY OF INDIA,
GANGTOK, SIKKIM.

S. N. DAS

BOTANICAL SURVEY OF INDIA,
CALCUTTA.

January 19, 1982.

REFERENCE

COWAN, A. M. & COWAN, J. M. (1929): The trees of Northern Bengal including shrubs, woody climbers. bamboos, palms and tree ferns being a revision of the list by Gamble.

PRAIN, D. (1903): Bengal plants. Calcutta.

22. CULTIVATION OF *VERNONIA SHEVAROYENSIS* GAMBLE (ASTERACEAE) — AN ENDEMIC AND ENDANGERED PLANT IN THE SOUTHERN EXPERIMENTAL GARDEN, BOTANICAL SURVEY OF INDIA

This note relates to a tree namely *Vernonia shevaroyensis* Gamble which is endemic to Shevaroy hills of Tamilnadu and is endangered. Collections of the species from its type locality were made by different collectors and deposited in the different herbaria of the Botanical Survey of India *viz.* Madras Herbarium (MH) and BSA. The details of collections are furnished in Table 1. Narayana (1979) has also collected the plant material from its type locality for his studies on trichomes of 15 species. *V. shevaroyensis* Gamble is a tall tree of *c.* 15 m in height, and grows near a perennial stream flowing through a private Coffee estate of Marapalam area (i.e. Kakasholey stream), on the way to Nagalur of Shevaroy hills at an altitude of approx. 1350 m. The species is considered a threatened species (Henry *et al.* 1978) as it has never been collected away from its type locality, and even there only a single well grown plant occurs. The restricted distribution of the plant in its type locality may be due to ecological preference and self-sterility of its seeds, which is common in Asteraceae (Walters 1979).

To save the plant from extinction it was decided by the Southern Circle of Botanical Survey of India to increase the plant population either by seed or vegetative propagation in the Experimental Garden at Yercaud, Shevaroy hills, and to conserve the tree in its natural habitat.

Fresh seeds were collected and sown for germination trials on different occasions but failed to germinate.

Thirty-five cuttings of soft and hard wood were brought in the month of August, 1979 and treated with 'Seradix' a commercial formulation of May & Baker for trial. Similarly, a second attempt was made by bringing fifty cuttings in the month of November, 1979. All the cuttings were watered regularly on the

TABLE 1

DETAIL OF HERBARIUM SHEETS OF *Vernonia shevaroyensis* GAMBLE

Place of collection	Altitude	Date of collections	Collected by	Name of the Herbarium where deposited	Remarks
Kakasholey area, Marapalam, Nagalur Road, Yercaud, Salem Dt.	1350 m.	15.4.1966	A. V. N. Rao	B. S. I. (MH), Coimbatore-3. Fld. No. 27460.	Tree, flowers pale blue.
—do—	—do—	29.8.1979	A. K. Banerjee	B. S. I. (BSA), Allahabad-2. Fld. No. 31404.	—

non-rainy days as the Experimental Garden gets two monsoon in a year. There is no rain in the month of October.

It was observed that only four cuttings from the first trial showed new growth after a lapse of forty-five days, and none of the cuttings showed any rooting response in the second trial group. Out of the four cuttings one did not establish due to damage caused by some pathogens while the others are growing luxuriantly under better care and have established this rare species in the Experimental Garden.

ACKNOWLEDGEMENTS

We are thankful to Dr. N. C. Nair, Jt. Director (S. Circle) and Dr. R. K. Chakraverty, Dy. Director (C. Circle) of the Botanical Survey of India respectively for their interest and encouragement.

BOTANICAL SURVEY OF INDIA,
EXP. GARDEN, YERCAUD,
SALEM DT., TAMILNADU-636 601,
January 7, 1982.

A. K. BANERJEE[1]
A. V. N. RAO

REFERENCES

HENRY, A. N., VIVEKANANTHAN, K. & NAIR, N. C. (1978): Rare and threatened flowering plants of South-India. *J. Bombay nat. Hist. Soc.* 75(3): 684-697.

NARAYANA, B. M. (1979): Taxonomic value of Trichomes in *Vernonia* Schreb. (Asteraceae). *Proc. Indian Acad. Sci.*, 88B(5): 347-357.

WALTERS, S. M. (1979): The Eastern England rare plant project in the University Botanic Garden, Cambridge, Proc. of the Practical role of Botanic Gardens in the conservation of rare and threatened plants, Bentham Moxon Trust. Royal Botanic Garden, Kew.

[1] *Present address*: Botanical Survey of India Indian Botanic Garden, Howrah-711 103, (W.B.).

23. NOTES ON RARE PLANTS FROM MADHYA PRADESH

During the floristic studies made recently in Raigarh District, Eastern Madhya Pradesh, many rare plants hitherto not reported in literature on this area were recorded. The present paper deals with nine taxa of flowering plants, and each is provided with a short description and other relevant data. All the specimens cited are deposited in the Herbarium of the Central Circle, Botanical Survey of India, Allahabad (BSA).

ACANTHACEAE

Aechmanthera gossypina (Nees) Nees in Wall. Pl. As. Rar. 3: 87. 1832. *Ruellia gossypina* Nees in Wall. Pl. As. Rar. 1: 38. t. 42. 1829. *Aechmanthera tomentosa* Nees in Wall. Pl. As. Rar. 3: 87. 1832; C. B. Clarke in Hook. f. Fl. Brit. India 4: 428. 1884 (incl. var. *wallichii*).

Erect undershrubs; stems villous or tomentose. Leaves 8-10 x 3-4 cm, elliptic-lanceolate, acute, rounded at base, crenate, tomentose. Panicles to 30 cm long. Bracts and bracteoles linear. Calyx 8-12 mm long, glandular-hairy. Corolla 2.0-2.5 cm long. Capsules 8 mm long, 8-seeded.

Distribution: Western and Eastern Himalayas.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Champa, 950 m., *Sen Gupta* 16516.

LAMIACEAE

Ajuga macrosperma Wall. ex Benth. var. **breviflora** Hook. f. Brit. India 4: 704. 1885; Mukherjee in Rec. bot. Surv. India 14: 226. 1940.

Erect or procumbent herbs; stems grooved, glabrous at base, hairy towards the apex. Leaves 4-10 x 2-5 cm, elliptic-oblong or ovate, base decurrent to the petiole, serrate; petioles 1.5-3.0 cm long. Spikes to 8 cm long. Corolla blue, often hairy; tube as long as or longer than the calyx, inflated at the base; upper lip 2-lobed. Stamens exserted. Nutlets pitted.

Distribution: Eastern Himalayas, Bihar.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Jashpur, 625 m, *Arora* 3827.

RUBIACEAE

Argostemma courtallense Arn. in Ann. Nat. Hist. 3: 22. 1839; Wight, Ic. t. 1160. 1846; Hook. f. Fl. Brit. India 3: 42. 1880.

Slender, erect, sparsely pubescent herbs; roots tuberous. Leaves opposite or in whorls of four, subsessile, 4-7 x 2-5 cm, orbicular or ovate-elliptic, subacute, membranous. Flowers in terminal umbels, 4-merous. Bracts foliaceous. Calyx campanulate; corolla white, rotate. Stamens inserted at the base of corolla-tube, exserted; anthers dehiscing by terminal pores. Capsules crowned by the limb of calyx.

Distribution: South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Kharra, 200 m, *Rathakrishnan* 21058.

RHIZOPHORACEAE

Carallia brachiata (Lour.) Merr. in Philip. J. Sci. Bot. 15: 249. 1919. *Diatoma brachiata* Lour. Fl. Cochinch. 296. 1790. *Carallia integerrima* DC. Prodr. 3: 33. 1828; Bedd. Fl. Sylv. t. 193. 1872; Henslow in Hook. f. Fl. Brit. India 2: 439. p.p. 1878.

Trees 3-5 m high. Leaves 5-10 x 2.5-5.0 cm, obovate or ovate-elliptic, shortly acute, margins revolute, coriaceous, shining. Flowers sessile in axillary, trichotomous cymes. Calyx

— tube campanulate; lobes 7. Petals white, orbicular, lacerate. Stamens 14. Stigma 4-5 — lobed. Berries globose, unilocular, one-seeded.

Distribution: Eastern Himalayas, West Bengal, Bihar, Uttar Pradesh, South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Bhubdeopur, 250 m, *Rathakrishnan* 19713.

URTICACEAE

Elatostema cuneatum Wight, Ic. t. 2091, f. 3. 1853; Hook. f. Fl. Brit. India 5: 568. 1888; Mitra in Bull. bot. Surv. India 9: 279-280 1967 (1968).

Slender, erect annuals, monoecious. Leaves subsessile, 2-4 x 0.8-1.5 cm, falcately cuneate, crenate-serrate in the upper part, sparsely setose above with linear cystoliths on both sides; lower leaves smaller than the upper ones, nearly entire. Stipules ovate. Flowers minute, regular on axillary capitate receptacles. Involucral bracts 2-4, ovate-oblong, cucullate. Male flowers: perianth-lobes 4, broadly ovate; stamens 4. Female flowers: perianth lobes 3, shorter than the ovary. Achenes ellipsoid, red.

Distribution: Sikkim, West Bengal, South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Bhubdeopur, 250 m, *Rathakrishnan* 21228.

MORACEAE

Ficus benjamina L. var. **comosa** (Roxz.) Kurz, For. Fl. Burma 2: 446. 1877; Hook. f. Fl. Brit. India 5: 508. 1888. *F. comosa* Roxb. Pl. Cor. 2: 14. t. 125. 1798; Wight, Ic. t. 658. 1843.

Large trees with drooping branches. Leaves 5-10 x 2-4 cm, ovate-elliptic, abruptly acuminate, subcordate at base, obscurely 3-ribbed. Figs sessile in axillary pairs, 1.2-1.6 cm across, subglobose or ovoid, red. Basal bracts 2-3, minute or one enlarged.

Distribution: Assam, Bihar, South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Kailasnatheswar gufa, 1200 m, *Rathakrishnan* 24504.

LOGANIACEAE

Mitrasacme pygmaea R. Br. var. **malaccensis** (Wight) Hara in J. Jap. Bot. 30: 204. 1955; Back. & Bakh. f. Fl. Java 2: 208. 1965. *M. malaccensis* Wight, Ic. t. 1601. 1850. *M. polymorpha* sensu C. B. Clarke in Hook. f. Fl. Brit. India 4: 80. 1883, *p.p.*, non R. Br. 1810.

Slender hispid annuals. Leaves 7-10 mm long, ovate-lanceolate, serrulate. Flowers in terminal pseudo-umbels, 4-merous. Corolla campanulate, white; lobes rounded, hairy within. Stamens 4, exserted. Styles 2, free at the base, connate above the middle. Capsules globose, crowned by the styles. Seeds ellipsoid, punctate.

Distribution: South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Sarainadi, 275 m, *Rathakrishnan* 21049.

LYTHRACEAE

Rotala occultiflora Koehne in Engl. Bot. Jahrb. 1: 152. 1881.

Small herbs 4-10 cm high. Leaves verticillate, 5-12 mm long, linear-lanceolate, rounded at base. Flowers in axillary cymes. Bracteoles 2-4 mm long, lanceolate, longer than the calyx. Calyx-lobes 5, ovate. Petals 0. Stamens 2-4.

Capsules 2-3 valved.

Distribution: South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Senna, 750 m, *Sen Gupta* 16481.

CAMPANULACEAE

Wahlenbergia erecta (Roth ex Roem. & Schult.) Tuyn in Steenis, Fl. Males. (ser. 1) 6: 113. 1960. *Dentella erecta* Roth ex Roem. & Schult. Syst. Veg. 5: 25. 1819. *Cephalostigma schimperi* Hochst. ex A. Rich. Tent. Fl. Abyss. 2: 2. 1851; C. B. Clarke in Hook. f. Fl. Brit. India 3: 428. 1881.

Erect annuals. Leaves subsessile, spirally arranged, 5-20 x 1.5-6.0 mm, oblong-elliptic, dentate-crenate. Flowers usually solitary or in lax cymes. Calyx-lobes linear-triangular, sparsely hairy. Corolla campanulate, bluish. Capsules 2-3 mm long, obconic, hispid. Seeds ellipsoid, compressed.

Distribution: Eastern Himalayas, Bihar, South India.

Specimens examined: MADHYA PRADESH: Raigarh Dist., Bagicha, 600 m, *Sen Gupta* 16451.

BOTANICAL SURVEY OF INDIA,
COIMBATORE-641 003.

N. C. RATHAKRISHNAN

BOTANICAL SURVEY OF INDIA,
ALLAHABAD-211 002,
December 31, 1981.

RAM SARAN

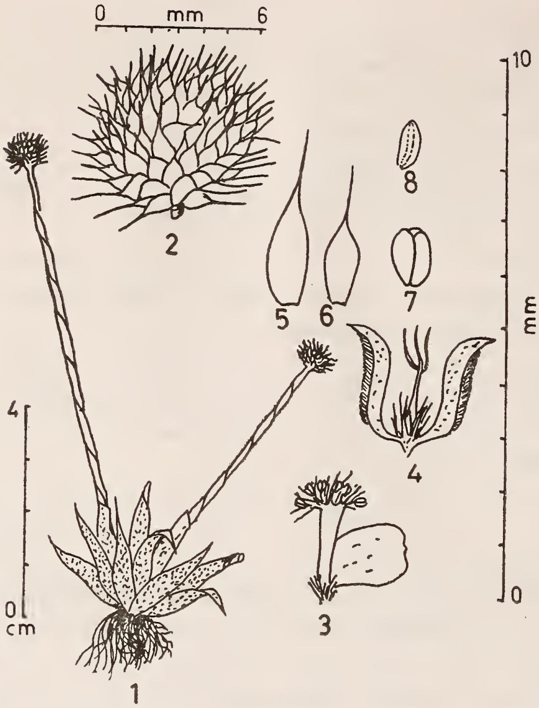
24. *ERIOCAULON ECHINULATUM* MART. (ERIOCAULACEAE) — A NEW RECORD FOR INDIA

(*With eight text-figures*)

This note records the occurrence of *Eriocaulon echinulatum* Mart. in Balphakram Wild Life Sanctuary in Garo Hills, Meghalaya. Hooker (Fl. Brit. India 6: 579. 1893) reported this species based on a collection of Wallich (Wall. Cat. No. 6082) from Kalaben in Burma. There are no collections of this either in the Herbarium of Botanical Survey of India at Shillong (ASSAM) or at the Central National Herbarium (CAL) from the Indian region. Therefore, the present collection from Meghalaya forms the first report of its occurrence from India, and is described here.

Eriocaulon echinulatum Mart. in Wall. Pl. As. Rar. 3: 29. 1832; Hook. f. Fl. Brit. Ind. 6: 579. 1893; Fyson in Journ. Ind. Bot. Soc. 2: 317. t. 47. 1921.

Roots fibrous, tufted. Scapes 5-10 cm high, stout, striate, twisted, glabrous, hairy only below the head. Leaves radical, 2-3 x 0.2-0.4 cm, subulate, acute, with distinct cross nervules. Sheaths as long as leaves. Heads 4-6 mm across, straw-coloured, with distinct, stellately radiating bracts. Receptacle villous. Involucral bracts lanceolate, ending in long aristate, glistening apex; floral bract longer than flowers, narrowed at base, abruptly narrowed to an elongate apex. Male flower: sepal 1, rounded or crenate; petals reduced to hairs or deformed; staminal column as long as sepals, slightly narrower towards villous base; stamens 6, at the top of the staminal column; anthers 2-celled, elliptic, black. Female flowers: sepals 2, falcately lanceolate, clawed, winged at the back, with serrate margin; petals 0 or reduced to hairs, partly concealing the ovary; ovary 3-celled, straw-coloured; style stout, 3-fid. Capsule triangular, truncate, membranous; seed



Figs. 1-8. *Eriocaulon echinulatum* Mart. 1. Habit sketch; 2. Head (enlarged); 3. Male flower; 4. Female flower; 5. Involucral bract; 6. Floral bract; 7. Capsule; 8. Seed.

elongate, with 5, pectinate, longitudinal ribs, and a black apical gland (Figs. 1-8).

Fls. & Frts.: August to October.

Notes: This is quite distinct from other species of the genus in having long, stellately aristate, glistening bracts, giving the head, a spiny appearance. Rare, in marshy, open grassland associated with *Eriocaulon alpestre, E. nepalense, Utricularia* spp., and grasses.

Distribution: Burma, Southern China and Thailand: presently recorded from Garo Hills, Meghalaya at 150-200 m elevations.

Specimens examined: *Y. Kumar,* 5737 Balphakram (Garo Hills). Specimens deposited in Herbarium of North-Eastern Hill University, Shillong (NEHU).

Department of Botany,
School of Life Sciences,
North-Eastern Hill University,
Shillong-793 014,
December 9, 1981.

S. MYRTHONG
Y. KUMAR
R. R. RAO

25. ON THE IDENTITY OF *OPHIORRHIZA SESHAGIRIANA* SIKDAR ET MAITI (RUBIACEAE)

The taxonomy of the genus *Ophiorrhiza* L. (Rubiaceae) in the Indian subcontinent has been under investigation by us for the last four years. Our attention was drawn to the recent publication of *O. seshagiriana* Sikdar et Maiti in J. Bombay nat. Hist. Soc. 78(1):143, 1981. The new species was collected from Jalpaiguri District in May 1976 and described on the basis of a single gathering *J. K. Sikdar* 4681A-E. We distinguished this species from O. *heterophylla* Dunn in Kew Bull. 1920 (4): 133. 1920, collected in December-March 1911-1912, from Kameng District (Abor Hill), Arunachal Pradesh *I. H. Burkill* 36116, 36616, 37334, 38158, 38171 in consideration of erect habit, cymes with short raceme like branches, shorter pedicel, triangular-ovate glabrous calyx lobes, cylindrical non bulbous corolla tube and shorter anther lobes. They further observed that the species is clearly recognizable by the presence of reflexed corolla lobes at blooming as seen in *O. heterophylla* where heterostyly is of common occurrence, while in this taxon this is not visible.

We rightly compared the material with *O. heterostyla* having reflexed corolla lobes. But the differences observed are not tenable as they resulted from superficial study and misinterpretation of morphological characters. It is evident from the specimens that the plant is not erect. Inflorescence is in dichotomous or trichotomous panicle of cymes, sometimes helicoid above. Pedicel varies from 1.25 to 3.5 mm in *O. heterostyla.* In *O. seshagiriana* the pedicels are generally shorter, but in *Sikdar* 4681D it is 2.25 mm long. Shorter pedicels and triangular-ovate glabrous calyx lobes are present in type material of *O. heterostyla.* Anther lobes are of the same size in both the species. Corolla tube is not generally distinctly bulbed at base in *O. seshagiriana,* but it shows a bulbous tendency or is slightly bulbous sometimes as in *Sikdar* 4681A. We failed to observe heterostyly in *O. seshagiriana* even though it is evident in the presence of short styled flower in *Sikdar* 4681B along with long styled ones. In view of all these variations observed on detailed scrutiny of the type specimens it is evident that *O. seshagiriana* does not differ specifically from *O. heterostyla* and it is reduced to synonymy as follows.

O. hererostyla Dunn in Kew Bull. 1920 (4): 133. 1920 (Syntype: Arunachal, Kament District (Abor Hill), *Burkill* 36116! CAL, 37334! CAL, 38158! CAL, K).

Syn. *O. seshagiriana* Sikdar et Maiti in J. Bombay nat. Hist. Soc. 78(1):142. 1981 (Type: West Bengal, Jalpaiguri District, Buxaduar, 1800 m (?), *J. K. Sikdar* 4681A Holotype: B-E Isotype! all in (CAL) SYNON. NOV.

This, however, extends the range of distribution of *O. heterostyla* from Kameng District (Arunachal) to Jalpaiguri District (West Bengal), 540 m-1020 m. This is also collected from Kachin State, Burma at a higher altitude 1500-2100 m as extent in herb. K.

Flowering time: December-May.

Distribution: North Bengal (Jalpaiguri) to Burma (Kachin State).

Probably this occurs all over the sub-Himalayan Ranges from Nepal to Burma at 540-2100 m.

BOTANICAL SURVEY OF INDIA,
INDIAN BOTANIC GARDEN,
HOWRAH-711-103,
December 2, 1981.

D. B. DEB
D. C. MONDAL

ANNUAL REPORT OF THE BOMBAY NATURAL HISTORY SOCIETY FOR THE YEAR 1982-83

EXECUTIVE COMMITTEE

President
Dr. Sálim Ali, D.SC., F.N.A.

Vice-Presidents
Mr. R. E. Hawkins
Mr. G. V. Bedekar, I.C.S. (Retd.)
Mr. D. J. Panday

Member
Director, Dept. of Science &
Technology, Government of India.

Ex-Officio

Elected Members

Mr. Humayun Abdulali
Dr. S. R. Amladi, M.D.
Prof. P. V. Bole
Mr. Divyabhanusinh Chawda
Dr. B. Dasgupta
Mr. H. K. Divekar
(*Honorary Treasurer*)
Mr. David Fernandes
Dr. C. V. Kulkarni, M.SC., PH.D.
Mr. Bansi Mehta
Mrs. Phillippa H. Mukherjee
Dr. A.N.D. Nanavati, M.D.
(*Honorary Secretary*)
Mrs. Dilnavaz Variava

ADVISORY COMMITTEE

Mr. H. G. Acharya	*Ahmedabad*
Mr. F. C. Badhwar O.B.E.	*New Delhi*
Dr. B. Biswas	*Calcutta*
Mr. S. Chaudhuri	*New Delhi*
Dr. Madhav Gadgil	*Bangalore*
Mr. N. D. Jayal	*New Delhi*
Mr. Shivarajkumar Khachar	*Jasdan*
Mr. Lavkumar Khacher	*Rajkot*
Mr. M. Krishnan	*Madras*
Mr. Duleep Matthai	*New Delhi*

HONORARY SECRETARY'S REPORT FOR THE YEAR 1982
99TH ANNUAL REPORT

MEMBERSHIP

In last year's report we drew attention to the fact that the number of ordinary members had crossed the 1000 mark after many years. The progress has been maintained but the increase during the year has not been satisfactory. The annual increase being only 93 as against 280 the previous year. Our recruitment of Compound Corporate members which is planned to be the mainstay of our corpus funding was rather disappointing.

We repeat our appeal to members to recruit more members, particularly Compound Corporate members, a field of recruitment in which we have done poorly indeed. The Compound Corporate Membership fee of Rs. 2500 offers the Society's facilities to company members for a period of 25 years. I hope members employed or involved in management or owning progressive companies will enroll them as members and provide the Society with a sound financial base.

Details of membership for the past quinquennium, showing members fully paid up on 31st December of each year are given in the statement below:

	1979	1980	1981	1982	1983
Ordinary members	640	660	764	1044	1137
Corporate members	184	180	168	176	162
Life members	274	305	327	349	407
Compound Corporate members	9	9	20	37	52
Student members	96	83	94	165	126
Honorary members	4	4	3	3	3
Vice-patrons	—	—	—	3	4
	1207	1241	1376	1777	1891

Members elected in 1982, but not paid	14
Members paid for 1981, but not paid for 1982	129

PUBLICATIONS

Journal:

The publication of the Journal failed to keep the momentum it had achieved the previous year and only one issue for the year namely the April issue for 1982 volume 79(1) was published.

Hornbill:

The Hornbill now in its 6th volume continued to retain its popular appeal and to attract new members. We again request members to remember that the Hornbill is largely a reflection of member talent. If you have good material in the form of articles and photographs, remember to send it over.

THE BOOK OF INDIAN BIRDS remains the Society's most popular publication. Publications are the one endeavour of the Society which has consistently realised funds for its activities. In the year under review three more books were added to our prestigious publications list namely GRASSES OF WESTERN INDIA by Toby Hodd, A SYNOPSIS OF THE BIRDS OF INDIA AND PAKISTAN 2nd edition by S. D. Ripley, and SOME BEAUTIFUL INDIAN CLIMBERS & SHRUBS by Bor & Raizada.

	Sales in		Balance stock
	1981	1982	21-12-1982
The Book of Indian Birds	2389	2019	3563
The Book of Indian Animals	1392	613	1897
Some Beautiful Indian Trees	234	188	1800
Glimpses of Nature in India Booklet	192	393	1215
Snake Chart	22	27	346
Checklist of the Birds of Maharashtra (2nd edition)	81	107	1783
Checklist of the Birds of Delhi, Agra, and Bharatpur	89	30	155
A Synopsis of the Birds of India & Pakistan	—	386	1586
Some Beautiful Indian Climbers & Shrubs	—	335	2558
Grasses of Western India	—	55	419

CHECKLIST OF THE BIRDS OF BORIVLI NATIONAL PARK by Humayun Abdulali published by the Society is on sale at the Sanjay Gandhi National Park, Borivli, Bombay. It is also available at the Society's Office.

Books under Publication:

ENCYCLOPEDIA OF INDIAN NATURAL HISTORY

Centenary Publications, 1883 – 1983

Work continues on the Encyclopedia which when ready will provide a ready reference volume for students in schools and colleges and to the general reader on the natural history of the Indian region.

A CENTURY OF NATURAL HISTORY

Centenary Publication 1883 – 1983

An anthology of the best natural history articles from the Society's Journal volumes covering general natural history, expeditions and explorations, hunting, fishing, conservation, wildlife photography, mammals, birds, reptiles, fishes, insects, other invertebrates and botany published during the hundred years of the Society's existence.

THE BOOK OF INDIAN REPTILES

By J. C. Daniel

One in the continuing series of the Society's publications on Indian Natural History, the Reptile Book describes the common reptiles of the Indian Sub-continent. The snake section will be illustrated with the paintings which originally illustrated Wall's *A popular treatise on the common Indian Snakes.*

CONSERVATION

The Society is recognised by the Central and State Governments in India and by International Organisations abroad as an authoritative source for information on conservation of wildlife and natural resources. This recognition is expressed in the form of association of its officials with State and Central Wildlife Advisory Boards and representation on the Specialist Groups of the Species Survival Commission of the International Union for the Conservation of Nature and Natural Resources.

As the Western Regional Representative of the Indian Board for Wildlife the Curator is a member of the State Wildlife Boards of Rajasthan, Maharashtra, Gujarat, Madhya Pradesh and Goa.

Moroccan Houbara Survey:

Dr Asad Rafi Rahmani, Senior Field Biologist in the Endangered Species programme participated, as a member of the ICBP team, in the survey of Moroccan Bustard habitats.

Bustard Conservation Consultation:

Dr Sálim Ali and Dr A R Rahmani visited UAE at the invitation of the UAE Govt. to advise on captive breeding of bustards.

SEMINARS & CONFERENCES

Primate Symposium, Baltimore, USA:

Dr. V. S. Vijayan, Project Scientist, Hydrobiology Project presented a paper on the Lion-tailed Macaque.

Eastern Ghats Seminar 23-27 *March*:

Dr. Sálim Ali, Mr. Humayun Abdulali, Prof. P. V. Bole, Mr. H. K. Divekar & Dr. R. B. Grubh participated in the seminar on the Eastern Ghats Environmental Situation.

Dr. V. S. Vijayan, Project Scientist, Hydrobiology Project, visited U.S. establishment concerned with wetland conservation at the invitation of the U.S. Fish & Wildlife Service.

Bird Hazard Conference:

Dr. R. B. Grubh attended the 16th Bird Strike Committee Europe, held between 18 and 21 of August at Moscow.

International Ornithological Congress:

Dr. R. B. Grubh, Mr. S. A. Hussain, Project Scientists, participated in the Congress at Moscow.

International Council for Bird Preservation:

Dr. R. B. Grubh and Mr. S. A. Hussain attended the Council Meeting at Cambridge, U.K.

MEMBERS' ACTIVITIES

Bird Count:

The monthly roadside count of birds at the Borivli National Park on the third Sunday of each month was continued. The data collected during the last three years was analysed. Report is available at the office for reference.

Nature Walks:

Nature walks were held in various areas of natural history interest around Bombay for birdwatching, vegetation, butterflies study. The programme helped in recruiting new members and fostering interest in natural history among members.

Nature Camps:

A nature camp was arranged at Bandhavgarh National Park, Madhya Pradesh from 17th to 29th and 75 members participated. List of birds and butterflies, vegetation seen were prepared. Another nature camp was arranged at Keoladeo National Park during October-November. 50 members participated. The committee recorded appreciation of the work done by Mr. P. B. Shekar and Mr. N. Chaturvedi for arranging these camps.

RESEARCH AND OTHER ACTIVITIES FUNDED FROM FIELD WORK FUNDS

The Field Work Funds available at the Society supported the following activities:

Sálim Ali Nature Conservation Fund:

(1) *Ecological Studies on the Gir Lion*: Mr. S. P. Sinha, Saurashtra University, monitored the possible progressive changes in the food and feeding habits of the Lion in relation to environmental changes. A preliminary report has been received.

(2) *Catchment Area Conservation*: Prof. Madhav Gadgil organised a study for the conservation of catchment areas of River Valley Projects in the Western Ghats. The report is awaited.

(3) *Cane Turtle Survey*: Mr. P. Kannan made a brief survey of Thattakkad and Parambilkulam sanctuaries in Kerala to study the status of the turtles. A report is available at the office.

(4) *Survey of Frogmouth*: Mr. Antony Powell a member from U.K. surveyed habitats likely to hold the rare frogmouth in the Kerala Forests. A report is available at the office.

(5) *Wildlife & Tourism*: Mr. Ullas Karanth, a member in Karnataka studied the impact of tourist traffic on Nagarhole Santuary. A report is awaited.

Sálim Ali–Loke Wan Tho Ornithological Research Fund:

(1) Mrs. K. R. Lalitha continued the study of the Comparative Ecology of Drongos with special reference to Ecological Isolation among them.

(2) Mr. Shahid Ali began observations on the ecology of Grey Partridge at Point Calimere.

(3) Mr. Anwarul Islam from Bangladesh began observations on the ecology of the Laughing Thrushes in the Himalayas and the Western Ghats.

(4) Miss Madeline Holloway studied the Breeding Biology of the Little Tern at Point Calimere.

5) Dr. J. V. Ramana Rao was assisted for a study of Grey Pelican at Nelapattu.

(6) Mr. S. A. Hussain was assisted for attending the International Ornithological Congress at Moscow.

(7) Financial assistance was extended to Mr. Koneri Rao, a member of the Society, to study Yellow-headed Bulbul in the Carnatic area of Tamil Nadu.

Pirojsha Godrej Fund:

Financial assistance was provided to:

(a) to Mr. Aloysius G. Sekar for the study of breeding Amphibians.

(b) Mr. S. M. Ketkar for the study of Premonsoon activities of crabs.

(c) Mr. M. Selvaraj for learning field identification of birds and bird banding.

RESEARCH FUNDED BY GOVERNMENT AND GOVERNMENTAL AGENCIES

Studies on the movement and population structure of Indian avifauna:

The main research stations at Point Calimere and Bharatpur operated throughout the year, for both bird ringing as well as ecological monitoring.

Subsidiary bird ringing stations were also operated at Harike Lake and Shivaliks range in Punjab with financial assistance from the Punjab State Government. Apart from these a Western Ghats monitoring programme for bird population studies was also launched after extensive survey carried out by project staff. Ringing camps at Kodaikanal, Mundanthurai, Kannikkatti, Ponmudi, Peermedu, and Periyar were operated briefly. The cooperation and assistance rendered by the Forest Departments of Tamil Nadu, Kerala and Karnataka, as well as the volunteers from Madras Naturalists Society, Kerala Naturalists Society and Wildlife Association of Ramnad is greatly appreciated.

Mr. S. A. Hussain, Project Scientist, visited U.K. to attend the ICBP International Conference and to attend the XVIII Internatioanl Ornithological Congress U.S.S.R. He also visited Wildlife Research Stations in U.S.A. and Canada at the invitation of the U.S. Fish & Wildlife Service. A meeting of the Wader Study group at Durham, U.K. was also attended. The Project Scientist appraised the researchers in these areas of the work done by the BNHS with slides, talks, etc.

An ecological study of bird hazards at Indian aerodromes:

Work on 3 major airfields including Bombay and Delhi was taken up and completed. Field studies covered identification of hazardous birds at these airfields, study of their ecological requirements, habits and movements at different seasons of the year and causes of their proliferation, and evolving procedures to reduce bird strike problems at these airports.

Revised bird strike data forms were prepared. A booklet on 'Potential Problem Birds' approved by the ARDB is nearing completion.

Dr. Robert B. Grubh attended a conference on Bird Hazards in Moscow, and the 16th bird strike committee in Europe, both in August 1982. He also attended a meeting of the operational problems panel of the R & D organisation, Bangalore to report on progress of work on Bird Hazard Project and undertook a study tour to the U.S.

Annual report for 1982 is under preparation.

Hydrobiological (Ecological) Research Station at Keoladeo Ghana Bird Sanctuary:

Data collection and detailed studies of Limnology, Comparative abundance of aquatic birds and fish fauna, were undertaken.

5 research assistants and 1 research biologist were recruited during the year.

Dr. Krishnamurthy, Director of Indian Toxicological Research Centre visited Bharatpur for consultation. An agreement also was made with the I.T.R.C. for analysis of water samples and to study air pollution.

Work programme as planned by the Project Scientist was reviewed by a Committee consisting of Dr. Sálim Ali, Dr. A. N. D. Nanavati, Dr. Madhav Gadgil, Dr. Anil Gore, Dr. Prasad, Dr. Gopalan, Dr. Robert B. Grubh and Messrs J. C. Daniel and S. A. Hussain.

Project Scientist visited U.S.A. on a study tour.

Mr. David Ferguson of U.S. Fish & Wildlife Service visited Bharatpur to study the progress of work.

Ecology of Certain Endangered Species of Wildlife and their Habitats:

Field surveys were carried out in Maharashtra, Gujarat, Saurashtra, Karnataka and M.P. for Great Indian Bustard. Study of breeding of Great Indian Bustard was done both at Karera (M.P.) and Solapur (Maharashtra), Entomological, Phenological work was also carried out. Study of succession dominance and population dynamics and distribution of different plant species was completed.

During field surveys eight bustards were sighted in Karmala,—Kameri areas in Maharashtra, fifteen in Karera (M.P.) with four chicks and six bustards were seen in Raneebennur (Karnataka).

Surveys were conducted for Lesser Florican in Saurashtra and Sailana (M.P.). All the nests of Floricans were either destroyed or the chicks and the hens killed by the tribals. This indicated very poor breeding success.

During the year Principal Investigator, Dr. Sálim Ali with Senior Field Biologist, Dr. A. R. Rahmani, visited U.A.E. at the invitation of the U.A.E. Government.

Dr. Rahmani also joined a survey party for Houbara bustard in Morocco.

DONATIONS

For Sálim Ali Nature Conservation Fund:

Dr. Sálim Ali	Rs. 25000.00

For Sálim Ali Nature Conservation Fund for Silent Valley Expenses:

Secretary, Science Centre, KSSP	Rs. 3400.00
World Wildlife Fund—India	Rs. 3000.00
	Rs. 6400.00

For Charles McCann Vertebrate Zoology Field Work Fund:

Mr. S. Chaudhuri	Rs. 600.00

Life Membership Fund:

Mr. D. J. Panday	Rs. 500.00

For General Fund:

		Rs.
1.	M/s Tata Engineering & Locomotive Co. Ltd.	10,000.00
2.	Dr. M. D. Gadgil	2,975.00
3.	Dr. C. V. Kulkarni	2,510.00
4.	M/s Bharat Tiles & Marble Pvt. Ltd.	2,500.00
5.	Mr. Bill Harvey	1,340.00
6.	Mr. Ben King, King Bird Tours	973.15
7.	Rev. E. D. Shaw	802.02
8.	Mr. Richard M. Leonard	193.43
9.	Mr. Achilles Olympus Morrokordatos	150.00
10.	Mr. M. A. Rau	101.00
11.	Miss Sadhana Nagendra	50.00
12.	Mr. M. J. Dastur	40.00
	Total	Rs. 21,634.60

REFERENCE COLLECTION

During the year under reference 159 specimens were registered into the collection.

Birds	109
Reptiles	7
Amphibians	23
Spiders	20
	159

NATURE EDUCATION SCHEME

More than 6000 students from 88 schools participated in our various activities. Besides school students 100 trainee teachers and about 330 college students took advantage of our programmes, in the form of field trips, visits to the Natural History Section of the Museum, the Zoo and the Aquarium, exhibitions and workshops.

A Nature Orientation course was arranged on 20th, 21st and 22nd September 1982 for primary and secondary biology teachers. 20 primary teachers from 13 schools and 33 secondary teachers from 26 schools attended the camp.

As part of the Maharashtra State Wildlife Week Celebrations for 1982 an exhibition on CONSERVATION OF WILDLIFE was arranged in the Society's premises for school children. 3108 students from 31 schools including 18 students from the Spastic Society's School visited.

MEETINGS

January: *Nature walk*: Kalina campus 10th January

Slide show: (a) Butterflies of Sikkim by Mr. N. D. Mulla
(b) Pachmarhi 20th January

Nature walk: Kanheri Caves to Mulund 24th January.

February: *Nature walk*: Tungareshwar 14th February
Nandumadhmeshwar on 20-22 February.

Talk/slide show: Ecological crisis in the Himalayas by Sunderlal Bahuguna.

March: *Nature walk*: Lion safari Park to Kokabi Hills 14th March.

Talk & slide show: High altitude flora of Western Himalayas by Dr. M. A. Rau 18th March.

April: *Nature Camp*: Bandhavgadh National Park, Madhya Pradesh from 17th to 29th April.

Nature walk: Evening nature walk from Kanheri Caves to Aarey Market 11th April.

June: *Slide show*: Bandhavgadh National Park 11th June.

Nature walk: Karnala Bird Sanctuary 13th June.

Film Show: Victor of the dryland, Lord of the air 13th June. The rise of the mammals 19th June. The hunter and hunted Life in the trees 20th June.

Nature camp: Matheran 26 & 27 June.

July: *Nature walk*: IIT Campus, Powai, 4th July. Rajmachi Fort 24 & 25 July.

August: *Nature walk*: Borivli National Park 8th August, Chinchoti falls 22nd August.

September: *Talk*: Problems of introduced species in Island ecosystem by Dick Veitch 8th Sept.

Film Show: Earth A Dying Planet. In search of a Green Planet? Are Lions Harmful? 16th Sept.

Nature walk: Monsoon flora from Kanheri to Tulsi Lake 19th September.

Talk/Slide show: Common Plants of Sahyadri by Mr. Almeida 23rd September.

Nature camp: Amboli 25th to 27th September.

October: *Film show*: Wild wings. Japanese Monkey 13th October.

Nature walk: Borivli National Park 17th October.

Talk: Naturalist experience in western Himalayas by Dr. Gaston.

Nature walk: At Dusk from Kanheri to Aarey Market 31st October.

Nature Camp: Keoladeo National Park 27th October to 5th November.

November: *Talk*: Sempach Bird Institute and its activities by Dr Edward Fuch 5th November.

Nature walk: Nagla Trail 28th November.

REVENUE & ACCOUNTS

The financial situation of the Society has improved, and the year's working showed a small surplus after provisions for staff Gratuity Fund & Centenary Celebrations Expenses.

STAFF

The Committee wishes to record its appreciation of the willing cooperation of the staff in the activities of the Society.

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUSTS ACT, 1950
SCHEDULE VIII VIDE RULE 17(1)

BALANCE SHEET FOR THE YEAR ENDED 31 *DECEMBER* 1982

FUNDS AND LIABILITIES		
Trust Fund on Corpus:		
Life Membership Fund (Individual):		
Balance as per last Balance Sheet	2,10,920.98	
Add: Amount received during the year	37,518.50	
Add: Donation received towards Life Membership Fund during the year	500.00	2,48,939.48
Corporate Life Membership Fund:		
Balance as per last Balance Sheet	61,750.00	
Add: Amount received during the year	10,950.00	72,700.00
Vice Patron Fees:		
Balance as per last Balance Sheet	22,500.00	
Add: Amount received during the year	15,000.00	
Add: Adjustments (per contra)	5,269.00	42,769.00
Fixed Assets Fund:		
Balance as per last Balance Sheet	76,970.96	
Add: Sale proceeds of old typewriters transferred from Income & Expenditure account	2,200.00	
	79,170.96	
Less: Depreciation of fixed assets for the year transferred	11,335.60	67,835.36
General Reserve Fund:		
Balance as per last Balance Sheet		37,952.71
Carried over		4,70,196.55

ASSETS		
Immpovable Properties:		Nil
Investments:		
Government Securities (At cost):		
3% Conversion Loan 1946/86 of the face value of Rs. 25,000/- (market value)	25,000.00	
$5\frac{1}{2}$% Government of India Loan 2,000 of the face value of Rs. 2,000/- (market value)	2,000.00	
In Units of the Face Value of:		
Rs. 2,14,625/- of the Unit Trust of India (under re-investment plan)	2,14,625.00	
In fixed deposit with Maharashtra State Road Transport Corporation:	60,000.00	3,01,625.00
Motor Cars, Motor Cycle & Auto Cycle		
Balance as per last Balance Sheet	2,399.55	
Less: Depreciation during the year	479.91	1,919.64
Furniture, Fixture and Equipment:		
Balance as per last Balance Sheet	78,805.34	
Add: Additions during the year	8,040.14	
	86,845.48	
Less: Depreciation during the year	10,855.69	75,989.79
Loans (Unsecured considered good):		
To employees		2,445.00
Carried over		3,81,979.43

FUNDS AND LIABILITIES		
Brought over		4,70,196.55
Building Fund:		
Banlance as per last Balance Sheet	4,697.68	
Add: Sale proceeds of old water tanks transferred per Income & expenditure account	1,800.00	6,497.68
Provision for Depreciation on Investment:		
Balance as per last Balance Sheet		9,266.10
Publication Fund:		
Balance as per last Balance Sheet	1,04,220.91	
Add: Grant received from U.S. Govt. transferred per Income & Expenditure account	80,000.00	
Add: Sale proceeds of Glimpses of Nature booklets published under WWF/Volkart Foundation grant	2,092.50	
Add: Grant received from Govt. of India, Department of Science & Technology for the publication of Some Beautiful Indian Climbers & Shrubs (in the earlier year transferred as per Income & Expenditure account)	40,000.00	
Add: Grant received from Smithsonian Research Foundation for publication of Grasses of Western India transferred per Income & Expenditure account	8,860.00	2,35,173.41
Other Earmarked Funds:		
As per Schedule 'A'		28,45,739.66
Carried over		35,66,873.40

ASSETS		
Brought over		3,81,979.43
Advances (Unsecured considered good)		
To employees (for project expenses)	1,37,836.36	
To employees and others for travel expenses etc.	3,421.64	
To others	6,805.46	
To Nature Education Scheme	7,842.57	1,55,906.03
Stocks:		
A) Publications as per inventory taken & certified by the Honorary Secretary	3,16,516.40	
B) Safety cartridges as per inventory taken & certified by the Honorary Secretary	9,530.35	
C) Cost of publications under preparation:		
1) Encyclopaedia of Indian Natural History	62,492.45	
2) A Century of Natural History	41,940.00	
3) Book of Indian Reptiles	15,816.00	4,46,295.20
Income Outstanding:		
Interest accrued	44,911.80	
Supplies and services	56,871.58	
Grant Govt. of Maharashtra for 1982-83	1,27,214.40	
Grant Govt. of India, Dept of Science & Technology for 1982-83	40,000.00	
Grant Indian National Science Academy for 1982-83	5,000.00	2,73,997.78
Income Tax Refundable:		7,047.40
Carried over		12,65,225.84

FUNDS & LIABILITIES		
Brought over		35,66,873.40
Staff Gratuity Fund:		
Balance as per last Balance Sheet	1,38,000.00	
Add: Interest received during the year	13,800.00	
Add: Provision during the year as per Income & Expenditure account	15,000.00	1,66,800.00
Provision for Capital Losses:		
Balance as per last Balance Sheet		15,025.23
Centenary Celebration Fund:		
Balance as per last Balance Sheet	1,00,000.00	
Add: Appropriation during the year per Income and Expenditure account	1,00,000.00	
	2,00,000.00	
Less: Preliminary expenditure during the year	8,153.55	1,91,846.45
Liabilities:		
For Expenses	1,15,496.42	
For Library Deposit	500.00	
For Sundry Credit Balances	2,34,892.38	3,50,888.80
Carried over		42,91,433.88

ASSETS		
Brought over		12,65,225.84
Cash and Bank Balances:		
A) In Current Account with:		
1) Grindlays Bank, M. G. Road, Bombay 400 023.	1,57,415.23	
2) Grindlays Bank, London	37,408.32	
3) Chartered Bank, Bombay-23.	1,01,717.62	
'In Savings Account with:		
1) Grindlays Bank, M. G. Road, Bombay	35,008.63	
2) Bank of India, Museum Savings Branch, M. G. Road, Bombay-23.	26,107.17	
3) Bank of Baroda, Univesity Branch, Bombay-23.	5,29,344.64	
4) Corporation Bank, Dalal Street Branch, Bombay-23.	6.73,997.34	
B) *In Fixed Deposit with*:		
1) Bank of India, M. G. Road, Bombay-23. consisting of Rs. 36,000/- of Dr. Salim Ali/Loke Wan Tho Ornithological Research Fund and Rs. 3,000/- of Col. Burton's Nature Conservation Fund	39,000.00	
2) Chartered Bank, Bombay-23	2,00,000.00	
3) Bank of Baroda, Bombay-23	1,00,000.00	
Carried over	18,99,998.95	12,65,225.84

FUNDS & LIABILITIES		
Brought over		42,91,433.88
Income and Expenditure Account:		
Balance as per last Balance Sheet	1,372.19	
Add: Excess of Income over Expenditure transferred from Income and Expenditure account	2,418.72	3,790.91
Total		42,95,224.79

ASSETS		
Brought over		12,65,225.84
Cash and Bank Balances (continued):		
Brought over	18,99,998.95	
In Fixed Deposit with (Continued):		
4) Grindlays Bank, Bombay-23, including Rs. 37,590/- of Charles McCann Vertebrate Zoology Field Work Fund	1,55,000.00	
5) Corporation Bank, Bombay-23 including Rs. 40,000/- Pirojsha Godrej Foundation Fund and Rs. 1,60,000/- of Dr. Salim Ali/Loke Wan Tho Ornithological Research Fund	2,00,000.00	
6) In monthly income certificate with Bank of India, Bombay-23 consisting of Rs. 6,06,100/- of Salim Ali Nature Conservation Fund and Rs. 1,11,136/- of Dr. Salim Ali/Loke Wan Tho Ornithological Research Fund	7,75,000.00	30,29,998.95
Total		42,95,224.79

Sd/- H. K. Divekar,
Honorary Treasurer,
Bombay Natural History Society

Sd/- A. N. D. Nanavati,
Honorary Secretary,
Bombay Natural History Society

As per our report of even date
Habib & Co.,
Chartered Accountants

Bombay, 23rd September 1983.

SCHEDULE 'A'

BOMBAY NATURAL HISTORY SOCIETY

SCHEDULE FORMING THE PART OF BALANCE SHEET AS AT 31ST *DECEMBER* 1982

Name of the Fund/Grand (1)	*Balance as per last Balance Sheet* (2)	*Amount received appropriated during the year* (3)	*Interest earned during the year* (4)	*Transfer from other funds* (5)	*Total of columns* 2, 3, 4, & 5 (6)	*Spent during the year* (7)	*Adjustments* (8)	*Total of columns* 7 & 8 (9)	*Balance as at 31st December* 1982 (6 *minus* 9) (10)
(1) Staff Welfare Fund	22,368.78	5,000.00	2,236.88	—	29,605.66	—	—	—	29,605.66
(2) Sálim Ali/Loke Wan Tho Ornithological Research Fund	2,71,136.52	—	—	—	2,71,136.52	—	—	—	2,71,136.52
(3) Col. Burton's Nature Conservation Fund	4,099.94	—	300.00	—	4,399.94	693.61	—	693.61	3,706.33
(4) Charles McCann Vertebrate Zoology Field Work Fund	37,590.78	600.00	3,759.08	—	41,949.86	443.52	—	443.52	41,506.34
(5) Sálim Ali Nature Conservation Fund	5,81,124.80	25,000.00	—	—	6,06,124.80	—	—	—	6,06,124.80
(6) Sálim Ali Nature Conservation Fund for Silent Valley Campaign expenses	5,587.25	6,400.00	—	—	11,987.25	645.28	—	645.28	11,341.97
(7) Col A. C. Moore Conservation Fund	5,269.00	—	—	—	5,269.00	—	5,269.00*	5,269.00	—
(8) Field Work Fund under Pirojsha Godrej Foundation	40,000.00	—	—	—	40,000.00	—	—	—	40,000.00
(9) Hospitality Fund (Dr. Sálim Ali)	1,000.00	—	100.00	—	1,100.00	165.70	—	165.70	934.30
(10) Projector Fund received from members	968.04	—	—	—	968.04	—	—	—	968.04
(11) Scholarship Fund under Sálim Ali/Loke Wan Tho Ornithological Research Fund Investment	20,448.05	—	27,113.65	—	47,561.70	39,038.51	—	39,038.51	8,523.19
(12) Conservation Fund under Sálim Ali Nature Conservation Fund Investment	10,707.09	—	60,612.48	—	71,319.57	40,425.81	—	40,425.81	30,893.76
Carried over	10,00,300.25	37,000.00	94,122.09	—	11,31,422.34	81,412.43	5,269.00	86,681.43	10,44,740.91

* Amount wrongly credited in the previous year now transferred to the appropriate head.

Name of the Fund/Grand (1)	*Balance as per last Balance Sheet* (2)	*Amount received appropriated during the year* (3)	*Interest earned during the year* (4)	*Transfer from other funds* (5)	*Total of columns 2, 3, 4, & 5* (6)	*Spent during the year* (7)	*Adjustments* (8)	*Total of columns 7 & 8* (9)	*Balance as at 31st December 1982 (6 minus 9)* (10)
Brought over	10,00,300.25	37,000.00	94,122.09	—	11,31,422.34	81,412.43	5,269.00	86,681.43	10,44,740.91
(13) Field Work Fund under Pirojsha Godrej Foundation Fund Investment	4,855.98	—	4,000.00	—	8,855.98	3,114.40	—	3,114.40	5,741.58
(14) *Grant Government of Maharashtra*:									
a) Grant for 1981-82 for Establishment & Building maintenance	23,739.41	—	—	—	23,739.41	23,739.41	—	23,739.41	—
b) Grant for 1982-83 for Establishment & Building maintenance	—	1,23,214.40	—	—	1,23,214.40	93,423.89	—	93,423.89	29,790.51
c) Grant for 1980-81 contd. 1981-82 contd. 1982-83 for Building repairs	89,371.36	—	—	—	89,371.36	89,371.36	—	89,371.36	—
(15) *Grant Government of India, Department of Science & Technology*:									
a) Grant for 1980-81 contd. 1981-82 contd. 1982-83 for Building repairs	2,00,000.00	—	—	—	2,00,000.00	9,770.97	—	9770.97	1,90,229.03
b) Grant for 1980-81 contd. 1981-82 contd. 1982-83 for Computer Analysing of Bird Banding Data	13,913.56	—	—	—	13,913.56	2,500.00	—	2,500.00	11,413.56
c) Grant for 1977-78 contd. 1978-79, 1979-80, 1980-81, 1981-82, & 1982-83 for the publication of Some Beautiful Indian Climbers & Shrubs	35,716.34	—	—	—	35,716.34	35,716.34	—	35,716.34	—
Carried over	13,67,896.90	1,60,214.40	98.122.09	—	16,26,233.39	3,39,048.80	5,269.00	3,44,317.80	12,81,915.59

Name of the Fund/Grand (1)	*Balance as per last Balance Sheet* (2)	*Amount received appropriated during the year* (3)	*Interest earned during the year* (4)	*Transfer from other funds* (5)	*Total of columns 2, 3, 4, & 5* (6)	*Spent during the year* (7)	*Adjustments* (8)	*Total of columns 7 & 8* (9)	*Balance as at 31st December 1982 (6 minus 9)* (10)
Brought over	13,67,896.90	1,60,214.40	98,122.09	—	16,26,233.39	3,39,048.80	5,269.00	3,44,317.80	12,81,915.59
(16) Grant for 1982-83 from Govt. of India Department of Environment for the expenses on Secretariat assistance to Dr. Sálim Ali for Environmental Research programme for processing of Archival material	—	12,300.00	—	19.17	12,319.17	12,319.17	—	12,319.17	—
(17) Grant Govt. of India, Ministry of Defence, Aeronautics Research & Development Board for An Ecological Study of Bird Hazards at Indian Aerodromes	11,47,388.26	—	—	—	11,47,388.26	2,61,725.70	—	2,61,725.70	8,85,662.56
(18) *Grants from US Department of the Interior Fish & Wildlife Service-National Park*:									
1) Studies on the movement & population structure of Indian avifauna	68,230.59	4,57,900.00	—	—	5,26,130.59	4,43,810.91	—	4,43,810.91	82,319.68
2) Hydrobiological (Ecological) Research Station at Keoladea Ghana Sanctuary Bharatpur	7,35,926.28	3,82,600.00	—	—	11,18,526.28	5,49,867.02	—	5,49,867.02	5,68,659.26
3) Study of Ecology of Certain Endangered species of Wildlife & their Habitats	2,66,797.94	—	—	—	2,66,797.94	2,58,065.15	—	2,58,065.15	8,732.79
(19) Grant from Chief Wildlife Warden, Chandigarh, Punjab, for Bird Ringing Project	16,513.00	24,500.00	—	—	41,013.00	22,563.22	—	22,563.22	18,449.78
Total	36,02,752.97	10,37,514.40	98,122.09	19.17	47,38,408.63	18,87,399.97	5,269.00	18,92,668.97	28,45,739.66

Regd. No. F. 244 (BOM)

BOMBAY NATURAL HISTORY SOCIETY

BOMBAY PUBLIC TRUSTS ACT 1950
SCHEDULE IX VIDE RULE 17(1)

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST *DECEMBER* 1982

EXPENDITURE

To *Expenses in respect of Properties*:		
Rates, taxes and cesses/repairs & maintenace:		
a) Met out of grant Govt. of Maharashtra for 1980-81 contd. 1982-83	89,371.36	
b) Met out of grant Govt. of India, Dept. of Science & Technology 1980-81 contd. 1982-83	9,770.97	99,142.33
,, *Building Maintenance Expenses*:		
(As per contra) Met out of the grant Govt. of Maharashtra for 1982-83	8,000.00	
Expenses other than Govt. grants	14,132.25	22,132.25
,, *Establishment Expenses*:		
Salaries including D. A. etc. (As per contra) from Govt. of grant for 1981-82	23,739.41	
for 1982-83	85,423.89	
Salaries including D. A. etc (other than above)	2,59,770.18	
Society's contribution to staff provident fund	12,707.00	
Postages	8,376.00	
Printing and stationery	18,592.34	
Carried over	4,08,608.82	1,21,274.58

INCOME

By *Rent* (Accrued & realised):	—	
,, *Interest* (Accrued & realised):		
On Securities	19,610.00	
On Fixed Deposits	2,01,416.64	2,21,026.64
,, *Donations general in cash*:		21,634.60
,, *Donations towards specific purpose*:		
Charles McCann Vertabrate Zoology Field Work Fund	600.00	
Sálim Ali Nature Conservation Fund	25,000.00	
Sálim Ali Nature Conservation Fund for Silent Valley Campaign expenses	6,400.00	
for Life Membership Fund	500.00	32,500.00
Donation from Thakoredas Purushottamdas Divaliba Charitable Trust for the publication of Hornbill Newsletter during 1982.		15,000.00
Transfer from Sálim Ali Nature Conservation Fund's Interest for the publication of Hornbill during 1982		18,000.00
Life Membership fees individual	37,518.50	
Corporate Life Membership fees	10,950.00	
Vice Patron fees	15,000.00	63,468.50
Carried over		3,71,629.74

EXPENDITURE		
Brought over		1,21,274.58
To *Establishment Expenses* (contd.):		
Brought over	4,08,608.82	
Advertisement	834.00	
Telephone Rental and call charges	3,646.90	
Meeting expenses including talks, film shows, etc.	9,323.50	
Conveyance and travelling expenses (local & upcountry)	4,200.65	
Bank charges	1,174.30	
Motor car maintenance expenses	700.00	
Medical expenses for staff members	4,830.00	
Leave travel expenses for staff members	8,638.75	4,41,956.92
,, *Audit Fees*:		1,000.00
,, *Amount Written off*:		
Bad debts		768.68
,, *Miscellaneous Expenses*:		
General charges	1,565.54	
Insurance premium	232.00	
Exchange fluctuation	2,682.42	
Repairs to furniture & equipment	1,846.80	6,326.76
,, *Depreciation*:		
On furniture and equipment	10,855.69	
On Motor cars, motor cycle & auto cycle	479.91	11,335.60
Carried over		5,82,662.54

INCOME		
Brought over		3,71,629.74
By *Grants*:		
A) *Govt. of Maharashtra*:		
1) For 1982-83 Establishment and Building Maintenance	1,23,214.40	
2) For 1982-83 Educational Activity (for Journal Printing)	4,000.00	
B) *Govt. of India*:		
1) Department of Science & Technology for 1982-83 for Journal printing expenses	40,000.00	
2) Department of Environment for Dr. Sálim Ali's Secretarial assistance for processing the archival material for environmental programme	12,300.00	
C) *Indian National Science Academy* for 1982-83 Journal printing expenses	5,000.00	
D) *Chief Wild Life Warden*, Chandigarh, Punjab for 1982-83 Bird Ringing project	24,500.00	
E) *US Department of the Interior, Fish & Wildlife Service—National Park*:		
1) For studies on movement & population structure of Indian Avifauna	4,57,900.00	
2) For Hydrobiological (Ecological) Research Station at Keoladeo Ghana Bird Sanctuary, Bharatpur	3,82,600.00	
Carried over	10,49,514.40	3,71,629.74

EXPENDITURE			
Brought over			5,82,662.54
To *Amounts transferred to Reserve or specific funds*:			
Grants transferred to relevant funds		10,00,514.40	
Donations towards specific funds transferred to relevant account in the Balance Sheet		32,000.00	
Life Membership fees transferred to Life Membership Fund in the Balance Sheet		37,518.50	
Corporate Life Membership fees transferred to Corporate Life Membership Fund in the Balance Sheet.		10,950.00	
Life Membership Donation transferred to Life Membership Fund in the Balance Sheet.		500.00	
Vice Patron fees transferred to relevant fund in the Balance Sheet		15,000.00	
„ *Transfer to Publication Fund*:			
Sale proceeds of Glimpses of Nature Booklet	2,092.50		
Grant from US Embassy for the publication of A Synopsis of Birds of India & Pakistan by Dillon Ripley	80,000.00		
Expenses on publication met out of specific grants (as per contra)			
Some Beautiful Indian Climbers & Shrubs	40,000.00		
Grasses of Western India	8,860.00	1,30,952.50	
Interest on fixed deposits transferred to respective funds		1,11,922.09	
Carried over		13,39,357.49	5,82,662.54

INCOME		
Brought over		3,71,629.74
By *Grants* (contd.):		
Brought over	10,49,514.40	
F) Grant from US Embassy for the publication of Synopsis of the Birds of India & Pakistan by Dillon Ripley	80,000.00	11,29,514.40
By *Income from Subscriptions & Entrance fees*:		
Membership subscriptions (individual)	69,073.89	
Corporate membership subscriptions	20,988.00	
Student membership subscriptions	1,885.00	
Subscriptions to Journal (non members)	29,817.57	
Entrance fees	8,810.00	1,30,574.46
„ *Income from Publications*:		
Journal sales	3,471.69	
Glimpses of Nature booklets	2,092.50	5,564.19
„ *Surplus on Sale of Books*:		
Book of Indian Birds	40,425.00	
Book of Indian Animals	17,739.00	
Some Beautiful Indian Trees	2,912.00	
Identification of Poisonous Snakes Chart	135.00	
Carried over	61,211.00	16,37,282.79

EXPENDITURE		
Brought over	13,39,357.49	5,82,662.54
To *Transfer to Reserve or Specific Funds*:		
„ *Building Fund*:		
Sale proceeds of old water tank	1,800.00	
„ *Fixed Assets Fund*:		
Sale proceeds of old typewriters	2,200.00	13,43,357.49
„ *Provisions*:		
For Staff Gratuity Fund	15,000.00	
For Centenary Celebrations Expenses	1,00,000.00	
For Staff Welfare amenities	5,000.00	1,20,000.00
„ *Expenses on Objects of the Trust*: *Educational*: from respective funds (as per contra)		
1. Expenses towards research scholarships and other expenses or ornithological research out of Scholarship Fund under Sálim/Loke Wan Tho Ornithological Research Fund	39,038.51	
2. Expenses on Bird Data Computer analysis study out of grant Govt. of India Dept of Science & Technology 1981-82 contd. 1982-83	2,500.00	
3. Expenses from the interest on Sálim Ali Nature Conservation fund (including Rs. 18,000 for the publication of Hornbill Newsletter as per contra) met out of interest from Sálim Ali Nature Conservation Fund interest	40,425.81	
Carried over	81,964.32	20,46,020.03

INCOME		
Brought over		16,37,282.79
By *Surplus on Sale of Books* (contd.):		
Brought over	61,211.00	
A Bundle of Feathers	963.25	
Some Beautiful Indian Climbers & Shrubs	6,097.51	
Synopsis of the Birds of India & Pakistan	14,260.56	
Grasses of Western India	618.40	
Butterflies of Indian Region	2,231.75	
Other publications	5,385.72	
Nature calendars	18,528.60	
	1,09,296.79	
Less: Excess of expenditure on packing charges	45.18	1,09,251.61
„ *Miscellaneous Income*:		
1) Fees for the use of Society's transparencies	7,200.00	
2) Library fines	31.70	
3) Miscellaneous receipts	586.58	
4) Income tax refund	523.00	8,341.28
„ *Administrative Fees*:		
For handling various funds during the year debited to respective funds		1,59,084.48
Sale proceeds of old iron water tanks & typewriters		4,000.00
Carried over		19,17,960.16

EXPENDITURE		
Brought over		20,46,020.03
To *expenses on objects of the trust*: (contd.)		
Brought over	81,964.32	
4. Expenses for field research under interest on Sir Pirojsha Godrej Foundation Fund investment	3,114.40	
5. Expenses under Charles McCann Vertebrate Zoology Field Work Fund	443.52	
6. Expenses on Silent Valley Campaign met out of Sálim Ali Nature Conservation Fund for Silent Valley Campaign	645.28	
7. An Ecological Study of bird hazards at Indian Aerodromes met out of grant received from Aeronautical Research & Development Board, Govt. of India, Ministry of Defence	2,61,725.70	
8. Studies on movement & population structure of Indian avifauna met out of grant US Department of Interior Fish & Wildlife Service—National Park Service	4,43,810.91	
9. Hydrobiological (Ecological) Research tation at Keoladeo Ghana Sanctuary Bhratpur met out of grant US Dept. of Interior, Fish & Wildlife Service—National Park	5,49,867.02	
Carried over	13,41,571.15	20,46,020.03

INCOME contd.		
Brought over		19,17,960.16
By *Expenses Transferred to Specific Funds*: (as per contra)		
Depreciation on fixed assets transferred to fixed assets fund	11,335.60	
Expenses on establishment & building maintenance transferred to Govt. of Maharashtra grant for 1981-82	23,739.41	
for 1982-83	93,423.89	
Expenses on Building repairs transferred to Govt. of Maharashtra grant contd. 1982-83 (as per contra)	89,371.36	
Expenses on building repairs transferred to Govt. of India Dept of Science & Technology grant contd. 1982-83 (as per contra)	9,770.97	
Carried over	2,27,641.23	19,17,960.16

EXPENDITURE		
Brought over		20,46,020.03
To *Expenses on the objects of the trust*: contd.		
Brought over	13,41,571.15	
10. Expenses for the study on Ecology of certain endangered species of wildlife & their habitats met out of the great US Dept. of the Interior, Fish & Wildlife Service—National Park Service	2,58,065.15	
11. Expenses under Col Burton's Nature Conservation Fund	693.61	
12. Expenses for Bird Ringing Project met out of grant from Chief Wildlife Warden, Chandigarh, Punjab	22,563.22	
13. Expenses met out of Dr Sálim Ali's Hospitality Fund	165.70	
14. Preliminary expenses on Centenary Celebrations met out of provision made during 1981	8,153.55	
15. Expenses for the publication of Some Beautiful Indian Climbers & Shrubs met out of grant Govt. of India Dept. of Science & Technology	35,716.34	
16. Expenses on Secretarial Assistance to Dr Sálim Ali for Environmental Research Programme for processing of archival material met out of grant from Govt. of India Dept of Environment	12,319.17	
		16,79,247.89
Carried over		37,25,267.92

INCOME		
Brought over		19,17,960.16
By *Expenses transferred to specific funds*: (as per contra) (contd.)		
Brought over	2,27,641.23	
Expenses on specific objects transferred to relevant Funds/Grants (as per contra)	16,79,247.89	
Amount spent on publications out of the grant received in the earlier years transferred to publication fund (as per contra)		
Department of Science & Technology, Govt. of India grant-in-aid for Some Beautiful Indian Climbers & Shrubs publication	40,000.00	
Smithsonian Research Foundation grant for Grasses of Western India publication	8,860.00	19,55,749.12
Carried over		38,73,709.28

EXPENDITURE				INCOME	
Brought over			37,25,267.92	Brought over	38,73,709.28
To *Journal Expenses*:					
1. For publishing the Journal of the Society		85,260.32			
2. For publishing Hornbill Newsletter		33,782.19			
,, *Library Account*:					
1. Subscriptions to other Societies	5,068.33				
2. Purchase of books	6,837.45				
3. Book Binding charges	2,120.15	14,025.93			
,, *Field study programme & other local field study expenses*		6,236.35			
,, *Maintenance of reference collections*:		6,717.85	1,46,022.64		
Excess of Income over expenditure transferred to Balance Sheet			2,418.72		
Total			38,73,709.28	Total	38,73,709.28

Sd/- H. K. DIVEKAR,
Honorary Treasurer,
Bombay Natural History Society

Sd/- A. N. D. NANAVATI,
Honorary Secretary,
Bombay Natural History Society

As per our report of even date
HABIB & CO.,
Chartered Accountants

Bombay, 23rd September, 1983.

BOMBAY NATURAL HISTORY SOCIETY

NATURE EDUCATION SCHEME

RECEIPTS AND PAYMENTS ACCOUNT FOR THE YEAR ENDED 31*ST DECEMBER*, 1982

RECEIPTS			PAYMENTS		
To *Balance as at* 1st *January* 1982			By Refund of Advance from		
with Grindlays Bank, Bombay			Bombay History Society		8,088.92
1) on Current Account	1,331.05		,, Salary Nature Education Organiser		16,203.90
2) In Fixed Deposit	6,000.00		,, Postages		381.75
With Nature Education Organiser	200.00	7,531.05	,, Printing & stationery		718.00
			,, General charges		3,704.91
,, *Grants*:			,, *Balance as at* 31*st December* 1982:		
Govt. of Maharashtra for the			1) With Grindlays Bank, Bombay	3,967.54	
year 1981-82		17,396.40	2) Cash on hand with Nature		
,, *Sale of Nature Study Booklets*:		246.35	Education Organiser	200.00	4,167.54
Advance from Bombay Natural					
History Society		7,842.57			
Interest earned on Fixed Deposit		248.65			
		33,265.02	Total		33,265.02

Sd/- H. K. DIVEKAR,
Honorary Treasurer,
Bombay Natural History Society

Sd/- A. N. D. NANAVATI,
Honorary Secretary,
Bombay Natural History Society

As per our report of even date
HABIB & CO.,
Chartered Accountants

Bombay, 23*rd September,* 1983.

MINUTES OF THE ANNUAL GENERAL MEETING OF THE SOCIETY WAS HELD ON MONDAY, THE 28TH NOVEMBER 1983 AT HORNBILL HOUSE AT 6.30 P.M. WHEN THE FOLLOWING WERE PRESENT:

1. Dr. Sálim Ali
2. Mr. D. J. Panday (in the Chair)
3. Mr. V. K. Paralkar
4. Mr. Oswald Thayil
5. Mr. S. D. N. Gandhi
6. Mr. M. R. Almeida
7. Mr. S. S. Mayekar
8. Mr. Shaman Udani
9. Mr. D. P. Bannerjee
10. Mr. J. P. Irani
11. Mr. M. D. Agharkar
12. Mr. Dilip G. Patil
13. Ms. Arati Kaikini
14. Commander GVK Unnithan, I.N.
15. Mr. Debi Goenka
16. Mr. Sunil R. Zaveri
17. Mr. S. D. Kowshik
18. Dr. P. J. Deoras
19. Mr. G. W. Taylor
20. Mr. K. N. Naoroji
21. Mr. R. E. Hawkins
22. Prof. P. V. Bole
23. Mr. J. C. Daniel
24. Mr. Bansi Mehta
25. Mr. Bibhas Amonkar
26. Mrs. D. S. Variava
27. Mr. Bittu Sahgal
28. Sanctuary Magazine
29. Dr. A. N. D. Nanavati
30. Mr. H. K. Divekar
31. Ms Heta Pandit
32. Mr. Shiraz Balsara
33. Mr. Kailash Gupta
34. Mr. S. D. Bhaumik
35. Mr. N. D. Mulla
36. Mr. K. Bhasker Rao
37. Mr. Ulhas Rane
38. Mr. Robert D'Souza
39. Mr. R. S. Moral
40. Mr. Sunil Joshi
41. Ms. A. S. Driver
42. Mr. Suresh Bhatkal
43. Mr. Ashok G. Puranik
44. Mr. S. Pereira
45. Mr. D. S. Manchekar
46. Mr. K. K. Vajifdar
47. Mr. N. K. Upadhyaya
48. One name is illegible.

At the request of the President, the Vice-President Mr. D. J. Panday took the Chair and conducted the proceedings.

The Honorary Secretary's Report for 1982-83 having been previously circulated, was taken as read. He drew attention to the salient features in his supplementary remarks, the Honorary Secretary stated that:

1. The total membership of the Society to date was 2162, of which 155 were Compound Corporate Members.
2. Two of the Centenary publications, namely
   (a) A PICTORIAL GUIDE TO THE BIRDS OF THE INDIAN SUBCONTINENT, by Drs. S. Dillon Ripley and Sálim Ali.
   (b) A CENTURY OF NATURAL HISTORY, edited by J. C. Daniel had been released.

Dr. P. J. Deoras inquired whether the the Project field work was carried on for the Society, or some other organizations. He was informed that studies made were for the Society. He was assured that either typed or cyclostyled copies of reports on field activities will be available to members for perusal as and when they are ready.

The Honorary Secretary's report was put to vote and accepted.

The Audited Balance Sheet of profit and loss account were next taken up for consideration. The Honorary Treasurer, Mr. H. K. Divekar asked whether members had any questions on the various heads mentioned in the accounts.

Dr. P. J. Deoras asked the Balance Sheet be explained, and the Honorary Treasurer after giving a resume of the various income and expenditure items, informed that there was a small profit of Rs. 2,418.72 during the year 1981-82.

As regards Dr. Deoras' query regarding provisions indicated at p. 688 of the Accounts the Honorary Treasurer explained that the Society had been able to set aside Rs. 15,000/- for Staff Gratuity Fund, Rs. 100,000/- for Centenary Celebration Expenses, and Rs. 5,000/- for staff Welfare amenities. The Honorary Treasurer further explained that we have been able to do the repair works to the building as indicated at p. 683 of the Accounts under the "14. Grant, Government of Maharashtra", acquire furniture and add most needed books to the Library.

Dr. Deoras asked for an explanation of the item "Silent Valley Campaign expenses" of Rs. 6,400/- detailed on p. 682. He was informed by the Honorary Treasurer that funds were raised by Mrs. D. S. Variava for propaganda to save the Silent Valley. Mrs. Variava thought it is useful to route these funds through the Society for utilizing them in making films and preparing other material.

Mr. Debi Goenka desired information on how the funds received from the Government were spent. He was told by the Honorary Treasurer that income received from government was matched by corresponding expenses.

Mr. Debi Goenka suggested that monies received for actual field camp expenses from members should be passed through the Society's books. The suggestion was accepted.

His suggestion that items of sundry credit balances (i.e. Rs. 234,892.38 on p. 680 of the account for example) be kept in short deposit accounts so as to give whatever interest that accrues thereon rather than in the current account was accepted.

After a few other questions had been answered, the accounts as presented were passed.

3. The Honorary Treasurer proposed Messrs Habib & Company as the Society's auditors for the ensuing year. The proposal was seconded, Dr. A. N. D. Nanavati and Messrs Habib & Company were unanimously appointed for 1983.

4. The Honorary Secretary explained that six candidates in addition to the panel proposed by the out-going Executive Committee have been nominated. Two of them, Mr. S. V. Pikale and D. S. Gaitonde, were Compound Corporate Members and as such are not eligible to be elected on the Executive Committee. Various opinions for and against such eligibility were expressed by members.

Finally Mr. M. D. Agharkar suggested that the issue of Compound Corporate Member's nominees contesting elections be settled by the General Body gathered for the Annual General Meeting. The proposal was seconded by Mr. Debi Goenka. The matter was put to vote the eligibility of Compound Corporate Members' nominees to contest Executive Committee elections was rejected by 10 voting for and 13 against it.

Mr. Debi Goenka suggested that biodata of the candidates contesting the Executive Committee elections be given with the voting paper. Dr. S. R. Amladi supported this suggestion. The Honorary Secretary suggested that not more than 50 word biodata be asked from the candidates to be published with the voting paper, and that the same should reach the Society within two weeks from the day of the Annual General Meeting — in this particular instance not later than 15.xii.1983. Put to vote 33 present voted for and 11 against the proposition.

In this connection Mr. H. K. Divekar, the Honorary Treasurer, suggested that candidates supplying false information be disqualified from contesting elections.

Mr. Debi Goenka suggested that there should not be perpetuating of the once elected Executive Committee and the outgoing Committee should not nominate themselves.

The Honorary Secretary mentioned two resolutions proposed by Mr. A. G. Nawalkar and read out the first resolution which was as follows:

Amendments to Rule 29 and 30

RESOLVED THAT rules 29 and 30 of the Memorandum and Rules of Registration be amended by substituting the word 10% of the members as it stood on the date of the meeting held on 22nd November 1982, in place of 10 members for calling Extraordinary General Meeting.

The Resolution was supported by Mr. A. G. Puranik.

In the discussion following, it was pointed out by Mr. Dutta Manchekar that a percentage would be difficult to assess as the total membership depended on how many had paid up on that date. Mr. G. W. Taylor suggested that a fixed number should be mentioned and suggested that 50 signatures would be a good number. Mr. Dutta Manchekar supported the proposal. After some discussion the figure of 50 signatories for requisitioning an Extraordinary General Meeting was accepted, by 25 voting for it and 18 against.

The proposal raised by Mr. G. W. Taylor to decide upon a quorum for conducting such a meeting was not discussed by the Meeting.

The amended Rule 29 now reads thus:

"The Committee may, whenever they think fit, convene an Extraordinary General Meeting and they shall on the requisition of at least 50 (fifty) of the members forthwith proceed to convene an Extraordinary General Meeting of the Society".

Mr. A. G. Nawalkar's second Resolution was then read out as follows:

"RESOLVED THAT the following words be and are hereby inserted at the end of Rule 32 A of the Society's Rules.

"A member of the Executive Committee who has served for a period of 6 years (i.e. has been nominated or elected for three successive terms) shall not be eligible to serve on the Executive Committee against without a break of at least one term of two years".

Mr. Debi Goenka expressed himself in favour of the Resolution. Mr. Ulhas Rane suggested that Committee members needed some time to understand the working of the Society and were not in a position to make a positive contribution until they had served on the Committee for some time. He felt that a resolution debarring experienced members from continuing to serve on the Committee was not in the Society's best interests. After some further discussion on the matter, the resolution was put to vote and was defeated with three present voting for it and 10 against.

The meeting terminated with a vote of thanks to the Chair.

In the ballot held in February 1984, the following were elected to the Executive Committee:

Mr. Humayun Abdulali
Mr. M. D. Agharkar
Mr. M. R. Almeida
Dr. S. R. Amladi
Mr. H. K. Divekar
Mr. R. E. Hawkins
Dr. Ashok Kothari
Mrs. Phillippa Mukherji
Dr. A. N. D. Nanavati
Mr. Ulhas Rane
Mr. Bittu Sahgal
Mrs. Dilnavaz Variava

ERRATUM

VOLUME 80, NO. 1: APRIL 1983

A Catalogue of the Birds in the Collection of Bombay Natural History Society-27.

On page 157,

For 1330 **Garrulax erythrocephalus erythrocephalus** (Hume)

Read 1330 **Grarrulax erythrocephalus erythrolaema** (Hume)

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The subscription of members elected in October, November, and December covers the period from the date of their election to the end of the following year.

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